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I, Kristen M Fleming, hereby submit this original work as part of the requirements for the degree of Doctor of Philosophy in History.

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Generating a New Ohio River: Ecological Transformation in the Nineteenth and Twentieth Centuries

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Generating a New Ohio River: Ecological Transformation in the Nineteenth and Twentieth Centuries

A Dissertation submitted to the

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By

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M.A., University of Cincinnati, 2014

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Abstract

Generating a New Ohio River: Ecological Transformation in the Nineteenth and Twentieth Centuries

By Kristen M. Fleming

Over the course of the nineteen and twentieth centuries, the Ohio River underwent an ecological transformation. This dissertation examines the various and competing visions for the Ohio River and how this transformation occurred through navigational and flood control engineering projects, extractive industries, and pollution from expanding municipalities and industry. Its narrative begins in the early nineteenth century, when explorers and naturalists begin to explore the young United States' Ohio Territory in the west. The 981-mile long river grew as a vital artery, as it allowed for movement from the confluence of the Allegheny and Monongahela Rivers in Pittsburgh to Cairo, Illinois, where the Ohio meets the Mississippi River. Settlement grew along the river's banks, and the residents depended on the healthy river not only for transportation but as a clean water source as well. Hoping to earn profit, residents and business owners from outside the valley also sought to exploit the river's resources, such as the freshwater mussels that lived in it. Industrial interests, such as that of coal, lobbied government to invest in infrastructure, from the removal of snags and dredging to permanent locks and dams, over the course of the nineteenth century. These programs, especially the creation of 52 locks and dams, resulted in the removal of habitats and the creation of a series of slack pools.

With the arrival of railroads, though, the Ohio River began to lose its dominance and the visions for the Ohio River changed as a result. Increasingly, residents and businesses and demanded the federal government also invest in projects to protection from river flooding, which grew in intensity and came to a head with the thousand-year 1937 flood, and pollution abatement

programs. This resulted in further engineering of the river and the Ohio Valley with the creation of flood control structures that included levees and reservoirs in the twentieth century. It also led to the creation of a regional regulatory body, the Ohio River Valley Sanitation Commission in 1948. This government involvement and hope for the remainder of the twentieth century is where the narrative ends.

Acknowledgements

Curiosity and a willingness to learn can only take one so far. Learning requires the generosity of others to share their knowledge, challenge your claims, provide feedback, and lend a listening ear. I am thankful for the support I have received while writing this dissertation. While I would love to individually thank everyone who had a role in the entirety of my education and growth, the following acknowledgements will focus on the years of my graduate studies.

Numerous faculty members were instrumental in my development as a historian. The University of Cincinnati's history department not only provided me with funding for coursework, teaching and dissertation writing but also offered a challenging, supportive environment. My advisor, Dr. David Stradling, consistently inspired me to become a better scholar and teacher. He taught me not just about the field, but what it means to be a good mentor. His ability to simultaneously provide both encouragement and substantial, timely feedback has contributed to my own approach to teaching. In addition, his courses challenged me to consider how my work can be used not just in the academic realm but to make contributions outside of the university. Dr. Steve Porter, another faculty member who served on both my comprehensive exams and dissertation committees, always showed genuine interest in my research and teaching. Not only was he willing to read numerous drafts, beginning with my first graduate research seminar, he consistently held my writing to increasingly higher standards. Dr. Porter pushed me to think beyond my narrow research interests and articulate how my research connects with that of other subfields. Like Dr. Stradling, Dr. Porter also taught me about teaching and mentorship, and I have always appreciated his close attention to detail. The work of Dr. Uwe Lübken, another member of my dissertation committee, inspired some of my questions about environmental history. As one of the few historians who has conducted research on the Ohio River, he

graciously served on my committee and has provided numerous insights since we met at a Filson Historical Society conference years ago. An additional thanks goes to Dr. Rob Gioielli, whose "Rethinking Porkopolis" project allowed me to delve a bit into public history. Dr. Gioielli served as an informal mentor in many circumstances and also encouraged me to think about how history can be a source of inspiration. Numerous other faculty members have provided support and taught fascinating, intellectually enriching courses influential in my thinking about the history field at large. They include:: Dr. Ethan Katz, who served on my comprehensive exam committee; Dr. Vanessa Walker, Dr. Williard Sunderland, and Dr. Chris Phillips, who taught some of my first graduate courses; and Dr. Allison Gilmore, now emeritus at The Ohio State University, who encouraged me to pursue my interests in environmental history and apply to graduate school. My intellectual and professional development would have looked very different without each of these people. I am grateful for their dedication to teaching, mentorship, and the development of our field.

Many outside groups contributed financial assistance and research support during my journey. The Cincinnati Public Library's Cincinnati Room, whose archivists were always helpful in locating materials, provided locating numerous materials that are important to telling the story of the nineteenth-century Ohio River. In addition, much of my research on navigational engineering began at the Filson Historical Society. From the Filson, I received a research fellowship and endless support, for which I am remarkably grateful. Dr. LeeAnn Whites of the the Filson also provided encouragement and guidance that facilitated the publication of a portion of Chapter 3 in *Ohio Valley History*. The Kentucky Historical Society, where I found wonderful resources, including beautiful photography of the nineteenth-century and early twentieth-century river, provided a research fellowship as well. Its staff, especially Dr. David Turpie and Dr.

Stephanie Lang, were welcoming and helpful. The Taft Center and University of Cincinnati's Graduate Student Association provided summer fellowships and conference travel funds. A summer fellowship with the Ohio Humanities Council and another fellowship with Dr. Kriti Nelson helped support the last few months of dissertation writing and furthered my skills in writing for the public. Without the financial support of these organizations and the University of Cincinnati's Department of History, I doubt would have been able to complete this dissertation.

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online dissertation writing groups helped me remember that “graduate student” was but only one piece of my identity and that I was never alone. Last, but certainly not least, I met one of my best friends along this journey: Dr. Vanessa de los Reyes. I learn so much from our conversations and she always encourages me to challenge myself. It was wonderful to have a study, writing, and lesson planning buddy, and I value our coffee (and knitting) meetings that provided accountability and produced a friendship that has lasted through the years.

Finally, my family contributed to my intellectual pursuits from an early age. My father, Dr. Paul Gaston, fostered my love for both ecology and the past. Our frequent trips to Battelle Metropolitan Park and the local library for genealogical research had such a profound impact on me, which I am still struggling to articulate. Thank you for all of my history books as a child and our long phone conversations and encouragement throughout this process. In addition, I am blessed to have grown my family during this venture. To Nathan, Annabelle, and Autumn Fleming, who have only known a wife and mother writing a dissertation: Thank you. Your dedication to my education and research matches my own. Annabelle and Autumn, may you always pursue your dreams and learn about the world around you- its past, its present and the many possibilities for its future. I hope, through watching my pursuit of a doctorate, you have both learned to never give up on your dreams and never let the words of others lead to doubt in yourself. May you find stories of inspiration in the stories of the past.

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Introduction

A portion of Winold Reiss's two-piece mosaic in Union Terminal[1]

In the Cincinnati Union Terminal's rotunda, a large mosaic divides the walls from the largest half-dome ceiling in the western hemisphere. It illustrates the story of Cincinnati's rise to its position in the mid-twentieth century, as a center of art and culture, transportation, and industry. The Ohio River serves as a constant in the background among the historical changes. Although not depicted front and center around the earlier periods, its placement suggests a prominent role in the city's evolution. In the section of the mural with the most modern technological and industrial innovation, the bustling river takes center stage. While the mural conveys the history of one city - Cincinnati, with its skyline and steamboats, the same story line could be proposed for other major cities along the flow of the Ohio River. The Ohio River allowed for easy travel and, with travel, came settlement, commerce, and the growth of cities. In

[1] Kristen Fleming. *Winold Reiss Mosaic*. June 2019. Union Terminal, Cincinnati, Ohio.

this way, the Ohio Valley owed much of its growth to the river. Reiss's mosaic depicts this constant resource in a consistently modernizing region.[2]

From a geological standpoint, the Ohio River is fairly young, having followed its modern course for approximately 100,000 years. Climate change and the subsequent glacier movements at the end of the Ice Age dissolved a major ancient river, known as the Teays, and caused the major system of rivers to move southward.[3] With the final retreat of glaciers from the modern Ohio Valley, the Ohio River's channel changed from a braided to a meandering flow. The Ohio took on its annual cycle, with seasonal flooding and occasional extreme floods.[4]

The current Ohio River flows 981 miles from east to west. It begins its journey at the confluence of the Allegheny and Monongahela Rivers and winds imperfectly southwestward to Cairo, Illinois. There, its relatively bluish waters meet the muddy Upper Mississippi River.[5] At the head of the river, it conveys 1,020 cubic feet of water a second during low water and as much as 460,000 cubic feet during flood stage. As the second largest U.S. river in terms of volume output, it feeds the Mississippi River substantially with as little as 22,142 cubic feet of water per a second or as much as 1,612,000 cubic feet of water per a second during flood.[6] At its narrowest

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[2] The City of Cincinnati commissioned Winold Reiss to create several paintings in Cincinnati's new train terminal, the Union Terminal, in 1933. Several famous boats are depicted in Winold Reiss's mosaic including FAIRPLAY, TOM GREENE, and the ISLAND QUEEN. (Gretchen Garner, *Winold Reiss and the Cincinnati Union Terminal: Fanfare for the Common Man*, Athens: Ohio University Press, 2016; Marjorie Byrnside Burress, *Led by the River: The Story of My Father's Towboating Days*. Senator John Heinz History Center, Pittsburgh.)

[3] R.E. Banta, *The Ohio,* 1949, Reprint. (Lexington: University of Kentucky Press, 1998), 19-22; KET PBS, "Where the River Bends: A History of Northern Kentucky," 2007.

[4] Duane Simpson and Nathan Scholl, "Geoarchaeology of the Falls of the Ohio River: Quaternary landforms at the Falls," *Quaternary International* Vol. 342: 141.

[5] Philip V. Scarpino, *Great River: An Environmental History of the Upper Mississippi, 1890-1950* (Columbia: University of Missouri Press, 1985).

[6] Chief of Engineers, United States Army, *The Ohio River* (Washington: United States Government Press, 1935), 1.

in the lower portion of the valley, the Ohio River channel falls through a set of rapids between present-day Louisville, Kentucky and New Albany, Indiana, known as "the Falls of the Ohio." Between these falls and in other portions of the river, bars that rise above the water's surface, commonly referred to as islands, divide the channel.[7] The early nineteenth-century river was known for its snags, rocks, and gravel and sand bars, as well as its variable channel width.[8] Ponds and wetlands persisted across the valley for much of the river's existence, up through the late nineteenth century.[9]

Approximately 16,000 years ago, Paleo-Indians moved into the Ohio Valley. These nomadic hunter-gatherers lived off the region's animals and plant resources. Despite the erratic climate during this period, the river provided resources and served as a means of transportation, making this area a populous region for Native American settlement.[10] As the climate became more temperature, the Paleo-Indians were followed by the Archaic hunter-gatherer cultures (7,000-11,000 years ago) and Woodland culture (3,000 years ago). Archaeologists credit the Woodland culture, first the Adena mound builders (3,000 to 2,000 years ago) and then the Hopewell culture (2,000 years ago to 500 B.C.), with the introduction of agriculture to the Ohio Valley. Although the reasons are still debated, the Hopewell culture died out, perhaps due to

[7] Some of these bars date as far back as the early Holocene. For geologists, this indicates that the area around the falls has been fairly stable, aside from natural phenomena such as floods that alter the explosion of these formations. This is the case in the instance of various floods between 250 and 1800 years ago. (Duane Simpson and Nathan Scholl, 148).
[8] Chief of Engineers, United States Army, *The Ohio River* (Washington: United States Government Press, 1935), 2.
[9] Simpson and Scholl, 141; Kevin F. Kern and Gregory S. Wilson, *Ohio: A History of the Buckeye State* (Wiley Blackwell, 2014), 7-8.
[10] Kevin F. Kern and Gregory S. Wilson, 20-24.

disease and war, and left the impression that the valley was "empty" for others to move into the region.[11]

The same river that supplied indigenous people with resources attracted Europeans to the Ohio Valley. Under pressure from the Haudenosaunee, or Iroquois, Confederacy who wanted to hunt for fur in the valley during the seventeenth century, several Native American tribes, such as the Algonquian-speaking tribes moved west out of the valley.[12] Therefore, between warfare and disease epidemics, when Europeans explored the region in the seventeenth and eighteenth century, this landscape had fewer demands placed upon it. European explorers found an ample forest beyond the riverbanks and interpreted this as untouched wilderness.[13] Mussel populations within the river, for instance, were able to increase without much disturbance. The head of the Ohio River, at the confluence of the Allegheny and Monongahela Rivers, grew as a strategic location for European settlers, and the Ohio Valley very much became a middle ground where cultures clashed.[14]

The Haudenosaunee Confederacy, which stretched into the Ohio River Valley when the Europeans came to the region, referred to the river as "Oyo," which French explorers interpreted as la belle rivière, or "the beautiful river." Those who experienced the beautiful river as the west, an area of wilderness, described this river in these terms. Harry Gordon, a British army captain, described the eighteenth-century Ohio River as the "most healthy (as no sort of chronic disorder

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[11] Kern and Wilson, 24-52; Darlene Applegate and Robert Mainfort, Jr., eds., *Woodland Period Systemics in the Middle Ohio Valley* (Tuscaloosa: University of Alabama Press, 2005).
[12] The Haudenosaunee, or Iroquois, Confederacy was a powerful alliance of Iroquois- language group villages of the Mohawk, Oneida, Onondaga, Cayuga and Seneca nations; Kern, 50.
[13] Some scholars estimate that the Ohio Valley populations were reduced by more than 80% in a few generations prior; Kearn, 50.
[14] Kern and Wilson, 47-53; Richard White, *The Middle Ground: Indians, Empires, and Republics in the Great Lakes Region, 1650-1815* (Cambridge: Cambridge University Press, 1991).

ever prevailed in it), the most pleasant, the most commodious, and the most fertile sport of Earth known to European people."[15] Part of the beauty of this river lay in its economic potential. After a period of limited settlement, as many Native Americans had moved out of the region, the Iroquois laid claim to, it appeared flooded with resources and opportunity. Prior to the creation of the United States, the Ohio Company moved into the region in speculation with the purpose of clearing the forest, settling the fertile lands along the Ohio and its tributaries, and using the river to supply the new settlements with resources. This is when the narrative that follows begins – in the moment of exploration and settlement of Euro-Americans, many of whom purchased land from a financially broke, new nation that hoped to exploit its vast inland resources in the name of development. Each generation that followed would use the tools of science and technology in ways that would transform the Ohio River and meet the perceived needs of the valley and nation.

The growth of the region led to a transformation of the Ohio River over the course of the nineteenth and twentieth centuries. While the long geological history of the river reveals it has no permanent path and flow, changes that happened over long periods of time took place at a rapid pace between the nineteenth and twentieth centuries due to humans' constant desire to create a river that fit the needs of a changing society. These nineteenth and twentieth century Americans armed themselves with modern science and technology that allowed for rapid change.

The Ohio River and its eighteen major tributaries contribute to a drainage basin of 203,910 square miles. However, it borders only six states: Pennsylvania, West Virginia, Ohio, Kentucky, Indiana and Illinois.[16] This path and drainage basin never defined a cohesive region.

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[15] Robert L. Reid, *Always a River: The Ohio River and the American Experience* (Bloomington: Indiana University Press, 1991), xi.

[16] These major tributaries include the Muskingum, Kanawha, Scioto, Miami, Kentucky, Wabash, Cumberland, and Tennessee Rivers. The river's drainage basin, or watershed, reaches much

Regions are constructs, defined in numerous ways: by language, culture, religion, economy, political boundaries, and so on. While the needs for commercial investment united the Ohio River Valley's residential and business lobbying efforts in at the nation's capital for much of the nineteenth and early twentieth centuries, the Ohio River Valley residents viewed the region as a conglomerate of neighbors, often competitive neighbors, rather than as a single community. Slowly, environmental pressures led to a conscious effort to redefine the valley based on the river drainage basin and the shared resource that had to be protected by all in the valley, rather than just the communities suffering the brunt effects of the pollution. "Generating a New Ohio River" shows how this regional identity based on ecological boundaries was created but also how the constant negotiation process of how a river should look and behave takes place in a condition of consistent environmental change.

"Generating a New Ohio River" serves as a model for ecological histories of less dramatic landscapes of the American Midwest. There are far more studies of landscapes and rivers of the western United States, where large-scale dams and reservoirs for hydropower and irrigation swiftly and substantially altered landscapes.[17] However, seemingly smaller engineering

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further than the states it borders. These states include Alabama, Georgia, Maryland, Mississippi, New York, North Carolina, Tennessee, and Virginia. (Reid, xii.)

[17] David P. Billington and Donald C. Jackson, *Big Dams of the New Deal Era: A Confluence of Engineering and Politics* (Norman: University of Oklahoma Press, 2017); Norris Hundley, *Water and the West: The Colorado River Compact and the Politics of Water in the American West* (Berkeley: University of California Press, 1975); Marc Reisner, *Cadillac Desert: The American West and Its Disappearing Water* (New York: Penguin Books, 1986); Patrick McCully, *Silenced Rivers: The Ecology and Politics of Large Dams* (London: Zed Books, 2001); Robert W. Righter, *The Battle of Hetch Hetchy: America's Most Controversial Dam and the Birth of Modern Environmentalism* (Oxford: Oxford University Press, 2005); Richard White, *The Organic Machine: The Remaking of the Columbia (*New York: Hill & Wang, 1995); Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West (*Oxford: Oxford University Press, 1985).

projects, which often served as prototypes for larger projects during the New Deal and postwar eras, impacted landscapes as well. While the Ohio River's ecological changes were less dramatic and visible than those of other river histories, the transformation that resulted from the creation of small dams and pools were ecologically significant, nonetheless. Studies tend to focus on the more dramatic transformations, yet this distorts our views of the larger landscapes' changes during the nineteenth and twentieth centuries.

This ecological history of the Ohio River is in direct conversation with a three main fields and subfields of history: environmental history of water, U.S. history, and American Political Development. While this is explicitly a story of a river in the United States, it speaks to a larger phenomenon of river engineering in the nineteenth century that greatly expanded in the twentieth century. Engineers professionalized their field, and they created an international community that spread ideas about ideal rivers and how they should or should not behave. These ideas became directly tied to ideas regarding nationalism and modernity.

While this work is one of the few attempts at an environmental history of the Ohio River, the environmental historiography of bodies of water, especially rivers, is vast and growing.[18] Authors of early river histories, like the field at large, initially focused on the rivers in the

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[18] Many historians, especially in the mid-twentieth century's shift towards covering regional and local histories as well, wrote on the Ohio River, but they do not seriously take the ecological changes into account that take place alongside the political, technological, and social changes. Some of these histories are the following: Banta, *The Ohio*; Joyce V. B. Cauffield and Carolyn E. Banfield, eds, *The River Book: Cincinnati and the Ohio (*Cincinnati: the Program for Cincinnati, 1981); Archer Butler Hulbert, *The Ohio River: A Course of Empire* (1906); John Ed Pearce and Richard Nugent, *The Ohio River* (Lexington: The University Press of Kentucky, 1989); Robert L. Reid, ed. *Always a River: The Ohio River and the American Experience* (Bloomington: Indiana University Press, 1991).

American West. Richard White, one of the earliest environmental historians, published *Organic Machine: The Remaking of the Columbia River* in 1995 when the field was still relatively new. White argues that energy and work bring humans and the river together, and river environmental histories continued this line of inquiry, studying how humans have used and re-engineered rivers. At various points, I use the terms "nature" and "wilderness" as those writing during the analyzed periods accepted the idea of wilderness as reality, but, to the best of my ability, I follow in the tradition of other environmental historians in portraying humans as part of nature and in understanding that wilderness in itself does not exist, but is instead a cultural construct.[19] While humans redesigned the Ohio River time and time again, the river continues to be natural, following its own systems and rationale.

The Ohio was and is a very important river that has been grossly understudied by historians. This eco-biography of the Ohio River expands the historical literature on the rivers of the United States in topics on Western expansion, nationalism, urbanization, pollution and technology. First, the Ohio River was important to westward expansion, which connects the environmental history of waterways to the process of growing the new nation. The river began to represent progress and a source of regional and national pride. Monographs such as *Rivers of Empire* by Donald Worster and *The Conquest of Nature: Water, Landscape, and the Making of Modern Germany* by David Blackbourn analyzed the centrality of waterways to development of a modern state and themes such as nationalism.[20] This work places the Ohio River within this

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[19] William Cronon, "The Trouble with Wilderness; or, Getting Back to the Wrong Nature," in *Uncommon Ground: Rethinking the Human Place in Nature*, 69-90 (New York: W.W. Norton & Co., 1995),

[20] David Blackbourn, *The Conquest of Nature: Water, Landscape, and the Making of Modern Germany (*London: Jonathan Cape, 2006); Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West (*Oxford: Oxford University Press, 1985).

conversation about the importance of rivers to the development of nation states. A number of other recent river histories were influential in this project, including Mark Cioc's *The Rhine: An Eco-Biography, 1815- 2000.*[21]

During the mid-nineteenth century, over a third of the United States' total population lived within the Ohio Valley. Therefore, the region's success was crucial to the overall growth and prosperity of the country, motivating humans in the Ohio Valley and Washington D.C. to make decisions based on economic concerns. Because a significant portion of the U.S. population resided in the Ohio Valley, it is important to understand what influenced their perceptions of the ideal river. The waterpower provided by the river represented opportunity and prosperity- if only humans could extract and efficiently utilize it. *Urban Rivers*, a collection of essays published in 2012, emphasized the role of rivers in the process of urbanization and the impact of urbanization on rivers.[22] By looking at how cities developed around and utilized rivers, and how rivers shaped cities, this collection of essays shows that it is difficult to look at rivers without considering their cities. This work continues the effort to view the "urban-ness" of rivers as essential to understanding riverine development. However, as much of the Ohio River flows through rural areas that are also very much are tied to the river, its connection to multiple towns and cities, and their conflicting and shared visions for the river, must be considered in my research and analysis.

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[21] Mark Cioc, *The Rhine: An Eco-biography, 1815-2000* (Seattle: University of Washington Press, 2002). Others, aside from those previously mentioned on European Rivers and the Mississippi River, include the following: James V. Hillegas-Elting, *Speaking for the River: Confronting Pollution on the Willamette, 1920s- 1970s* (Corvallis, OR: Oregon State University Press, 2018); Amahia Mallea, *A River in the City of Fountains: An Environmental History of Kansas City and the Missouri River* (Lawrence: University Press of Kansas, 2018).
[22] Stéphane Castonguay and Matthew Evenden. *Urban Rivers: Remaking Rivers, Cities, and Space in Europe and North America (*Pittsburgh: University of Pittsburgh Press, 2012).

While much of its story appears to be regional, a closer analysis shows that the Ohio River played a vital role in the shaping of the United States and, thus, is an integral part of the national story. Its flow encouraged westward movement, but it was also an important site during the Seven Years War, Fugitive Slave Acts enforcement, the Abolitionist movement, nineteenth and twentieth century industrialization, and even the war mobilization efforts during and following the Second World War. As Richard E. Banta pointed out in his history of the Ohio River, it was a location of both war and peace. For this reason, the river had an important role in American political development, as some visions of the river were prioritized over others.

Third, I examine early efforts to address regional pollution. Scholars have written on the topic of pollution abatement in waterways, but these narratives focus on very definite geographical boundaries, such as the cities of Chicago or Cleveland.[23] By the very nature of the 981- mile path of the Ohio River, which defines the borders of many states, pollution abatement must be discussed in much broader terms than those confined to a city.[24]

Fourth, similar to the narratives of the Rhône and Rhine Rivers in Europe and rivers dammed by humans in the Western United States, technology and technocrats figure prominently in the story of the Ohio River.[25] This is another area that the Ohio's story adds to the literature.

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[23] Libby Hill, *The Chicago River: A Natural and Unnatural History (*Chicago: Lake Clermont Press, 2000); David Stradling, *Where the River Burned: Carl Stokes and the Struggle to Save Cleveland* (Ithaca: Cornell University Press, 2015).

[24] William Ashworth, *The Lake, Great Lakes: An Environmental History (*Detroit, MI: Wayne State University Press, 1987)*;* Margaret Beattie Bogue, *Fishing the Great Lakes: An Environmental History, 1781-1933* (Madison: University of Wisconsin Press, 2000); Benjamin Ross and Steven Amter, *The Polluters: The Making of Our Chemically Altered Environment* (Oxford: Oxford University Press, 2010); Martin Melosi, *The Sanitary City: Environmental Services in Urban America from Colonial Times to the Present* (Pittsburgh: University of Pittsburgh Press, 2000).

[25] Sara Pritchard, *Confluence (*Cambridge, Mass: Harvard University Press, 2011); David Blackbourn, *The Conquest of Nature: Water, Landscape, and the Making of Modern Germany (*London: Jonathan Cape, 2006); Christof Mauch and Thomas Zeller, *Rivers in History:*

While much of this scholarship discusses the technology and its influence on the environment, what is missing is what made these technologies attractive, where these technologies came from, and who implemented them on the waterway. In the case of the Ohio River, this background is important as it shows the region's and nation's desires, and their belief that technology could be easily transported to another context.

In this dissertation, five thematic chapters guide readers chronologically through the Ohio River's environmental transformation across the nineteenth and twentieth centuries: exploration, flow modification and river engineering, extraction of resources, flooding, and recreation and restoration. The first chapter discusses how explorers and settlers in the early nineteenth century encountered, perceived, and experienced the Ohio River. I show that explorers, such as John James Audubon, recognized the beauty of the Ohio River and its valley but also its potential as a natural resource that could be used to grow a modern, distinct region. Audubon was in awe of the changes taking place in the river during the nineteenth century, but he would have been even more surprised to see what followed. The state took significant interest in these explorations, as it aided the growth of the nation.[26]

The second and third chapters focus on nineteenth century changes to the river. Between the removal of sandbars, consistent dredging, early locks and dams, and the extraction of mussels, an important filter animal, the river's ecology changed so much in less than a century that humans observed and noted the swift changes. Commerce benefitted from the removal of sunken trees, islands, and aggregate that frequently accumulated on the bottom of the river.

Perspectives on Waterways in Europe and North America (Pittsburgh: University of Pittsburgh Press, 2008); Richard White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill and Wang, 1996).

[26] James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press ,1998).

Islands appeared as obstructions to the neat, straight and ideally open flow of the river. Shallow spots in the river, believed to be caused by unnecessary soil and gravel in the riverbed, were also dangerous and inconvenient to boats on the river. Over the course of the nineteenth century, humans intentionally removed these inconveniences with the help of manpower, capital, and knowledge through organizations, such as the Army Corps of Engineers.[27] However, the islands, rubble, and sunken trees, like mussels, had ecological value in the river as habitats that allowed insects and small fish, important players in the aquatic food chain, to thrive.

Chapter four, entitled "From Expected Tragedy to Prevention Plans," focuses on the changing ideas regarding natural disasters and permanent flood prevention structures between the 1880s and famous 1937 floods. Over the course of a few decades, Ohio Valley residents pushed engineers to find permanent solutions to the growing flooding issue, as had been done with low-water troubles in the previous generation.

The fifth and final chapter discusses the regional response to the transformed river to restore the beautiful river that had been lost to municipal and industrial pollution. Typhoid and cholera were significant problems during the nineteenth century, but water-born illness, from gastroenteritis to ear infections, continued to harm Ohio Valley residents in the early twentieth century. Cities and their industries directly dumped waste into the river without treatment, and downstream cities were disproportionately at a disadvantage. By the 1920s, public health officials in the Ohio River Valley viewed the river as a health hazard that required drastic measures and created a regional plan and governing body to enforce policies to clean up the

[27] Todd Shallat, *Structures in the Stream: Water, Science, and the Rise of the U.S. Army Corps of Engineers* (Austin: University of Texas Press, 2013); John Krige, ed., *How Knowledge Moves: Writing the Transnational History of Science and Technology* (Chicago: University of Chicago Press, 2019).

river.[28] Therefore, we can also see a shift in understanding a river as divided between cities to a river that defines a regional identity.

To cover such a broad geographical area and a century and a half, this study is thematic and, at times, jumps from location to location along the river. Some areas along the river are not as thoroughly covered as others, but a single work can only cover so much. However, the themes should guide future scholars into suggested major topics of study for the Ohio and other rivers that do not necessarily fit the coastal or western ones that gained a significant amount of interest from historians in the past.

Humans continuously defined and refined the Ohio River to meet the needs of the day, and how this had lasting impacts on the river's ecology, which were unpredictable to humans and encouraged additional reinventions. The river continued to flow through all of these changes, but the ecology of the Ohio River at the end of the twentieth century hardly resembled that of the early nineteenth century. The only certainty in the history of rivers is change, and the Ohio River is no exception.

[28] Ohio Sanitary Bulletin, Vol. 4, 28-29. *Google Books*; Regional Water Management Task Force, "Framing Paper: Regional Water Management in Southwestern Pennsylvania," July 2006. http://www.chec.pitt.edu/IOP_Framing_Paper.pdf

Chapter One:

The Commercial River: Controlling Nature with Maps and Engineers

The nineteenth century marked the beginning of a human-induced ecological change in the Ohio River. Speculators and explorers flocked to the Ohio Valley in the early 1800s with the expectation that the river and its surrounding land would provide endless opportunity, especially in farming. Their purpose was to establish farms and cities and tie them together with commerce along the main artery of movement, the Ohio River. The focus on growth influenced the river in several ways between the early 1800s and 1880s. Three impacts demonstrate this general transformation of the river. First, naturalists, scientists and engineers aimed to discover as much of the riparian environment, from its flora and fauna to the river's path and flow. Their sharing of these discovers and consistent pleas from the commercial interests led to the beginning of state-sanctioned navigational improvements within the river. With an "improved" water highway, river-dependent industries grew within the valley. Each of these developments reflects a view of the Ohio River that led to a fundamental change in the use of the waterway. During this period, residents of the Ohio Valley established the burgeoning region as an industrial and commercial powerhouse and began generating a new river.

In the first two decades of the nineteenth century, settlers established cities to serve the commercial and agricultural interests of the region. Already by 1820, seventy-three steamboats worked on the Ohio River and carried as much as 33,000 tons of goods up and down the waterway each year. By 1840, more than one-third of all Americans lived in the early west, most of them arriving by way of the Ohio River. Much of this population concentrated in cities along the river. Cincinnati, with a population of over 46,000, ranked the sixth largest city in the United

States in 1840; Louisville and Pittsburgh, both with populations of over 21,000, ranked the sixteenth and seventeenth largest U.S. cities. The Ohio Valley was growing in both population and influence, increasingly connected to both the U.S. south and global trade networks, and this growth was connected to the river.[29]

Historians who wrote on the Ohio Valley in the nineteenth century appropriately included the Ohio River in their narratives. Richard Wade's foundational work, *The Urban Frontier: The Rise of Western Cities, 1790-1830*, explored the ways that settlers in major cities such as Pittsburgh, Lexington, Cincinnati, and Louisville turned these metropolises into vital centers of commerce, industry, and urban culture -- "spearheads of the frontier."[30] Urban historians discuss the movement of the Valley from being the "Western frontier" to an important commercial and industrial region with large cities to supply a significant workforce. These narratives discuss land speculation, population growth, and even inter-city tensions but also typically focused on individual major cities such as Cincinnati and Pittsburgh.[31] As the Ohio River was the political border separating free and slave states, historians of the Civil War and African-American history have also taken an interest in Ohio and the tensions spanning the river. Historian Nikki Taylor pointed out that housing opportunities in Cincinnati greatly depended on proximity to the river, in which minorities and immigrants lived in the lower-priced land that was more susceptible to

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[29] "Population of the 100 Largest Urban Places: 1840" https://www.census.gov/ ; Christopher Phillips, "The Breadbasket of the Union," *The New York Times*, April 8, 2012. https://opinionator.blogs.nytimes.com/2012/08/08/the-breadbasket-of-the-union/

[30] Richard Wade, *The Urban Frontier: The Rise and Western Cities, 1790-1830* (Cambridge, MA: Harvard University Press, 1959), 1.

[31] Wade; Darrel E. Bigham, *Towns & Villages of the Lower Ohio* (Lexington, KY: The University Press of Kentucky, 1998); John Jakle, I*mages of the Ohio Valley: A Historical Geography of Travel, 1740-1860* (New York: Oxford University Press, 1977); Gautham Rao, "Thomas Worthington and the Great Transformation: Land Markets and Federal Power in the Ohio Valley, 1790- 1805," *Ohio Valley History* 3 , no. 4 (2003): 21-33.

river flooding and pollution. Others emphasize that the Ohio, as a main artery in the nineteenth century, connected the industrial northwest to the slave trade of the south.[32] Historians of technology take great interest in the growth of steamboats and bridges along the length of the Ohio River as well.[33] However, largely missing from this historiography is the profound ecological transformation all of these developments wrought that directly influenced humans' visions of their landscape and their place within it.

This demographic and economic growth regime influenced the way in which Ohio Valley residents utilized the river. Settlers built as close to the river as they could, anticipating this proximity to the riverbank will give them an edge in commercial activities. However, this close proximity posed risks in terms of flooding. The river opportunities could lead to substantial wealth, if the fluctuations could be predicted and controlled.[34]

As historians have well documented and acknowledged in scholarship, the Ohio River was the resource that brought people to the region, but in most narratives it quickly becomes merely a backdrop for all of these urban, technological, political, cultural, and industrial

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[32] Matthew Salafia, *Slavery's Borderland: Freedom and Bondage Along the Ohio River* (Philadelphia: University of Pennsylvania Press, 2013); Darrel E. Bigham, *On Jordan's Banks: Emancipation and its Aftermath in the Ohio River Valley* (Lexington: University Press of Kentucky, 2006); Nikki M. Taylor, *Frontiers of Freedom: Cincinnati's Black Community, 1802-1868* (Athens, OH: Ohio University Press, 2005); Zachary Bennett, *One River, One Nation: The Ohio River in an American Borderland, 1800-1850, Master's thesis,* Miami University, 2013.
[33] Louis C. Hunter, *Steamboats on the Western Rivers: An Economic and Technological History* (Cambridge, MA: Harvard University Press, 1949); Kim M. Gruenwald, "'The invention of the steam-boat was intended for US:' Steamboats and Western Identity in the Early Republic," *Ohio Valley History* (2012): 3-20; Jerry Green, "Wheeling and the Development of the Inland Riverboat Trade," *Ohio Valley History* (2010): 46-69; Harry Sinclair. *From the Early Side-Wheelers to the Big Packets* (New York: Bramhall House, 1967).
[34] Uwe Lübken, "Rivers and Risk in the City: The Urban Floodplain as a Contested Space," in *Urban Rivers: Remaking Rivers, Cities, and Space in Europe and North America*, ed. Stéphane Castonguay and Matthew Evenden (Pittsburgh: University of Pittsburgh Press, 2012), 130-144.

developments.[35] Nevertheless, these stories as written alone reveal a larger truth of how humans have come to view the river as a less important resource; by the mid-twentieth century, people rarely interacted with the river on a day to day basis and, therefore, less important to protect. Although residents thought they were becoming less connected to the river, they were still intimately tied to the vital resource. The river and humans still influenced each other and, due to human intervention, were dependent on each other. Over the nineteenth century, humans consciously altered the river through the extraction of resources, the removal of obstacles, and the construction of structures such as dams, locks, and reservoirs. However, the river pushed back. Its natural tendencies continued, and its ecosystem could only adapt so quickly to profound alterations in a relatively short period.

To create areas suitable for the development of both urban and agricultural areas with river access, settlers and engineers cleared vegetation around the river, allowing pollution to find its way into the river at increasing rates, even well before significant industrial endeavors. Residents of the Ohio Valley took actions to control the river and re-create their relationship with the Ohio River. They found value in its flora and fauna only to the degree to which it could provide for economic gain. Settlers paid no attention to the way flora and fauna constituted an ecosystem. The ecology, as a prominent science and widespread concept, did not develop until the end of the twentieth century; therefore, biologists discussed nature and specific species, but humans did not connect the health of these to the health of the riparian environment.[36] Unwanted

[35] Lee Burns, "The Ohio River, Its Influence on the Development of Indiana," *Indiana Magazine of History* 19 (1923), 169-181.
[36] Edward J. Kormondy, "A Brief Introduction to the History of Ecology," *The American Biology Teacher* 74 (2012), 441-443.

natural processes never did truly cease despite all of humans' efforts and often the efforts to mitigate one natural process would, undesirably, exaggerate another.

It would be ahistorical to pick a particular point of time and declare the state of the environment as truly "natural;" however, all histories must have a beginning.[37] While humans long occupied and directly and indirectly altered their environment before the settlement of Europeans and their descendants in the Ohio Valley, data points in the long natural history speak to and guide our understanding of specific ecological revolutions. Where the story begins does not imply that the environment was in a "natural state." Rather, the environment at the point of study is itself a historical artifact, produced by many forces at play during that period- and earlier.[38]

The first two decades of the nineteenth century are appropriate as a starting point to analyze the recent ecological transformations of the Ohio River. Native Americans resided in the Ohio Valley during and long before this period, a fact not easily forgotten by settlers, but these humans did not purposefully alter the river to the extent their successors would during the nineteenth and twentieth centuries. Europeans and their descendants were fairly new to the region at the turn of the nineteenth century, carrying with them long-lived ideas on the wilderness and their need to tame it.[39] The writings of explorers from this period recorded much

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[37] William Cronon, "A Place for Stories: Nature, History, and Narrative," *The Journal of American History* 78 (1992, 1347- 1376).
[38] Kevin F. Kern and Gregory S. Wilson, *Ohio: A History of the Buckeye State* (Wiley Blackwell, 2014); Darlene Applegate and Robert Mainfort, Jr., eds., *Woodland Period Systemics in the Middle Ohio Valley* (Tuscaloosa: University of Alabama Press, 2005).
[39] Roderick Nash, *Wilderness and the American Mind* (New Haven: Yale University Press, 1982); George Perkins Marsh, *Man, and Nature: Or, Physical Geography as Modified by Human Action* (Seattle: University of Washington Press, 2003).

on the state of the river before significant concentrated settlement and the river alterations that fed this development.

In the early nineteenth century, agriculture brought many settlers and writers to the Ohio Valley region. Speculators and land surveyors were important to this process of settlement, as people sought information about the land. These occupations informally became experts on the environment, either through simple exploration or systematic record keeping of the land and its resources. Navigators also became valued experts, as their business and survival depended on their knowledge of the Ohio River. They had to learn every detail of the river and recognize when changes occurred in the channel. As Philip V. Scarpino succinctly writes, "a pilot had to learn the shape of the river, the face of the water, and the important features of the shoreline."[40] Their knowledge was extensive and intimate – and highly valued.

Although settlers were interested in the land and the possibility for agricultural growth, the main avenue for travel for newcomers was the Ohio River, as it was a much easier and faster than traveling over the Appalachian Mountains. Therefore, recordings of the river were both important and plentiful. Writers, such as John James Aubudon, Thomas Ashe, Zadock Cramer, and C.S. Rafinesque, provide accounts of the river. Their descriptions are helpful in establishing a pre-settlement picture of the Ohio Valley to assess how the river changed over the nineteenth century and the factors that contributed to the transformation.

The Living River

John James Audubon, the naturalist famous for his paintings of birds, moved to Kentucky in 1808 and widely traveled the Ohio and Mississippi Rivers for his observational work. After

[40] Philip V. Scarpino, *Great River: An Environmental story of the Upper Mississippi, 1890-1950 (Columbia: University of Missouri Press, 1985).*

his first encounters with the Ohio River Valley, Audubon remarked on the beauty of the landscape. "Nature," he wrote in his journal, "seems to have felt a partiality towards this portion of the country." Audubon found the river islands, contrasting in size and form, rising out of the "bosom of the water" and a varied river whose "winding course… frequently brings you to places where the idea of being on a river of great length changes to that of floating on a lake of moderate extent." Even the visibility of these islands changed with the seasons, as the "little islands [were] frequently overflowed during great freshets or floods, and receive[d] at their heads prodigious heaps of drifted timber." The inconsistent river, he wrote, served to "enhance the general interest of the scenery." For him, humans did not need to enhance or simplify the river; it was this variation that provided the Ohio River its charm. Audubon expressed "great concern [with] the alterations that cultivation would soon produce along those delightful banks," but did not note any specific potential alterations. It was clear to Audubon that settlement and industry was well on its way toward the Ohio Valley, with noting the many sluggish flatboats in his river travels.[41]

Audubon, as a trained observer of wildlife, offered many valuable pieces of information to understand the river as it was at the beginning of the nineteenth century. Audubon noted the seasonal variability of the river. The Ohio River has a cyclical cycle, with annual spring and fall freshets, summers often marked by long periods of drought, and winters with large chunks of ice that slowly flow down the river. When winter ends and the ice begins to melt, the river rises. In addition, Audubon found a very unpredictable winding pattern in the river's channel. The Ohio winds and changes direction so frequently that the north and south banks are more useful for

[41] As quoted in "Indian Summer on the Ohio in 1810," *Kentucky in American Letters* (Cedar Rapids, Iowa: The Torch Press, 1913), 49-50.

navigators to note than true north and south. Audubon also found a valley and river with a variety of habitats and an abundance and diversity of flora and fauna. These plants and animals lived in the wooded areas and wetlands that surrounded the area and around the large amounts of timber that collected in the river from eroding banks. The river's flora and fauna of the valley adapted to this river, and therefore they came to depend on the seasonal cadence, sunken timber, and so on. Many other explorers left behind accounts, which provide a valuable look into the Ohio River of the early nineteenth century and how it functioned without significant intervention.

The perspective of navigators also tells the story of the natural river. These navigators, explorers, surveyors, and so on accumulated knowledge and make them reliable reporters on the natural state of the Ohio River in the twentieth century. Navigators described the river with language similar to Audubon's. Thomas Ashe, an Irish novelist who traveled down the Ohio River in 1806, also noted the several "islands, rocks, ripples, snags, sawyers, and a variety of other dangers" that made river navigation dangerous, especially at night and during foggy days.[42] In addition, another explorer by the name of Thomas Hamilton wrote in a letter that he was also "particularly struck with the vast masses of drift-wood carried down by the stream" between Cincinnati and Louisville from the edges of the riverbank.[43]

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[42] As quoted in "Thomas Ashe, Travels in America, Performed in the Year 1806. For the Purpose of Exploring the Rivers Alleghany, Monongahela, Ohio, and Mississippi, and Ascertaining the Produce and Condition of their Banks and Vicinity (London, 1809),"; William J. Morison, and James Holmberg. *Historical Evidence of Ohio River Bank Erosion (*U.S. Army Corps of Engineers Louisville District, 1983), 65-66.

[43] As quoted in "Thomas Hamilton. Men and Manners in America, Vol. 11," Morison, William J. and James Holmberg. *Historical Evidence of Ohio River Bank Erosion (*U.S. Army Corps of Engineers Louisville District, 1983),100.

Both low and high water could pose problems for navigators but were typical of the Ohio. In his 1797 journal, Francis Baily noted that the flooding around Wheeling and Marietta caused large trees to "continually [drift] down the river."[44] Between the swift currents and trees, Baily and his crew struggled to navigate the river safely. Another navigator and keen observer with a formal scientific background, Thomas Hamilton, outlined the general knowledge of river levels in his writings:

> The Ohio is very low during the winter season, so much as so, as often to obstruct the navigation in its upper parts. The period when the floods come down and cause it to rise depends upon those causes which apply to rivers in general in similar situations; namely, the breaking up of the winter, when the snow on the mountain-tops begins to melt, and the rains to descent, which in this country is about February or March, though there are generally partial floods before Christmas, which rise the river sufficiently for the purposes of navigation. From this time, then, till May the rivers continue to rise; when they gradually decline again, and by the end of June in most seasons they are too low for the purpose of navigation.[45]

Hamilton, like Audubon, points out the seasonal variability of the river, but he provides a bit more detail. When the snow melted at the end of the winter months, and the spring rains began, the water rose. However, as the rain slowed by early summer, the river experienced low water levels. Ashe agreed with Baily's assessment of water levels. Ashe wrote, "Boats have frequently passed from Pittsburgh to the mouth of the Ohio in fifteen days. However, twenty days is a good spring passage. In summer, six, eight and even ten weeks are often required to effect the same

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[44] As quoted in "Francis Baily Journal of a Tour in Unsettled Parts of North America in 1796 & 1797. London: Baily Brothers, Royal Exchange Buildings," Morison, William J. and James Holmberg. *Historical Evidence of Ohio River Bank Erosion (*U.S. Army Corps of Engineers Louisville District, 1983), 65-66.

[45] As quoted in "Francis Baily Journal of a Tour in Unsettled Parts of North America in 1796 & 1797. London: Baily Brothers, Royal Exchange Buildings," Morison, William J. and James Holmberg. *Historical Evidence of Ohio River Bank Erosion (*U.S. Army Corps of Engineers Louisville District, 1983), 65-66.

voyage."[46] This slower journey was the result of less water and therefore a slower current in the river during the summer months. The seasonable variability became a well-known trait of the river.

The water rises of the spring and winter played a vital role in the Ohio Valley, moving sediment and organic material. This increase in water created the fertile farmland that attracted so many people to the region. However, it had another evolutionary purpose. Some fish became dependent on such flooding; for example, the alligator gar, absent in the twentieth century river, depended on the seasonally flooded lands for spawning.[47] The flood waters allowed the gar and other migratory fish to travel upstream more easily.

Navigators also noted the ponds and marshes along the Ohio's path, including marshes near the town of Gallipolis, Ohio, about four miles downstream of Point Pleasant, West Virginia. When the river was high, and its banks overflowed, the extra water rushed into such ponds. The pools caused anxiety, and settlers believed them to be a source of unhealthiness and referred to the ponds as evil. Water in these pools did not frequently flush and, therefore, water was stagnant and often attracted insects such as mosquitos. As miasma was still the predominate theory of disease during the early nineteenth century, the towns drained swamps as a public health measure to rid the area of fetid smells.[48] Later, farmers would also drain wetlands to make room

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[46] As quoted in "Thomas Ashe, Travels in America, Performed in the Year 1806. For the Purpose of Exploring the Rivers Alleghany, Monongahela, Ohio, and Mississippi, and Ascertaining the Produce and Condition of their Banks and Vicinity (London, 1809)," Morison, William J. and James Holmberg. *Historical Evidence of Ohio River Bank Erosion (*U.S. Army Corps of Engineers Louisville District, 1983), 70.

[47] John O. Whitaker, Charles Amlaner, Marion T. Jackson, George Parker, and Peter Scott. *Habitats and Ecological Communities of Indiana: Presettlement to Present* (Bloomington, IN Indiana University Press, 2012), 142.

[48] Miasma is the belief that bad air emanating from decaying organic material causes disease. As one Ohio Valley newspaper article explained, "The nose acts like a custom-house officer to the system. It is highly sensitive to the odor of the most poisonous substances… it recognizes the

for agriculture.[49] Nevertheless, these ponds captured some of the flooded waters and served the ecological purpose of keeping water in an area. Standing water is vital to avoid additional flooding downstream and in maintaining wetlands, which served as natural filtration systems and resting grounds for migratory birds. These wetlands provided habitat for a number of local species.

Ashe noted that the Ohio River channel and its banks were irregular in themselves. At points, the river was relatively wide, but it thinned and appeared "intricate" in other stretches.[50] This irregularity caused difficulty for navigators who had not studied the advice of other travelers. Around Manchester, Ohio, for example, an island divided the river into two channels, and Ashe found the channel along the right shore challenging to navigate due to it filling up with soil. A "filling up" process of the river is mentioned often in accounts, in which the banks and river itself were in a period of constant change, especially following floods. This regular flux made navigation difficult and unpredictable.

As early as 1806, though, observers already envisioned significant development along the Ohio River. Settlement increased close to the river, due to Americans placing a high value on river access. They saw such residential development as problematic from the beginning, even

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fetid smells of drains, and warns us not to inhale the polluted air ("Noblesville: The Nose," *The Indianapolis Journal* (Indianapolis, IN), March 15, 1891).

[49] Kenneth R. Olson and Lois Wright Morton, "The 2011 Ohio River flooding of the Cache River Valley in southern Ohio," *Journal of Soil and Water Conservation*, 2014.

[50] "The channel from Charlestown continued on the Virginian shore till I came to Beach Bottom, when it wore over to the right-hand side. The navigation then became intricate, being obstructed by a ripple… From the land island to Wheeling, I beg you to observe how accurate one must be." As quoted in "Thomas Ashe, Travels in America, Performed in the Year 1806. For the Purpose of Exploring the Rivers Alleghany, Monongahela, Ohio, and Mississippi, and Ascertaining the Produce and Condition of their Banks and Vicinity (London, 1809)," Morison, William J. and James Holmberg. *Historical Evidence of Ohio River Bank Erosion (*U.S. Army Corps of Engineers Louisville District, 1983), 71.

leading to an 1801 act in the town of Marietta to "preserve the banks" of the river for commerce through the creation of wharves.[51] Ashe wrote of Charlestown (now Wellsburg, West Virginia): "Owing to the avarice of the proprietor of the terrace, and a disgraceful absence of judgment and taste, he has sold his title to the water side, and the purchasers are now building on it; turning the back of their houses immediately close to the edge of the bank… The violation of tastes, it seems, is not to go unpunished."[52] While Ashe discussed this issue as a matter of taste, citizens of Charlestown were maximizing the land around the riverbanks and building as close to the water as possible. Not to do so was seen as wasteful. He also mentioned, "in some places [near Limestone (now Maysville), Kentucky] there is barely room between the houses and the edge of the bank for a passable road."[53] The settlers' building patterns made their intention to use their river primarily for the purpose of commerce, foreshadowing that dramatic change would occur in the coming decades.

By 1826, significant transformations had taken place. Audubon pined for the earlier Ohio Valley, revealing how quickly the region had changed with urbanization and river alterations.

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[51] Wharves are flat pieces of land along the edges of the river that serve as designated areas for loading and unloading people or goods. They could be in the form of actual structures or simply open land in enough size to Preservation of the banks was not conservation but preserving areas to serve economic goods; "An Act of the 'Town of Marietta," 1801, Morison, William J. and James Holmberg. *Historical Evidence of Ohio River Bank Erosion (*U.S. Army Corps of Engineers Louisville District, 1983), 181.

[52] As quoted in "Thomas Ashe, Travels in America, Performed in the Year 1806. For the Purpose of Exploring the Rivers Alleghany, Monongahela, Ohio, and Mississippi, and Ascertaining the Produce and Condition of their Banks and Vicinity (London, 1809)," Morison, William J. and James Holmberg. *Historical Evidence of Ohio River Bank Erosion (*U.S. Army Corps of Engineers Louisville District, 1983), 65.

[53] As quoted in "Thomas Ashe, Travels in America, Performed in the Year 1806. For the Purpose of Exploring the Rivers Alleghany, Monongahela, Ohio, and Mississippi, and Ascertaining the Produce and Condition of their Banks and Vicinity (London, 1809)," Morison, William J. and James Holmberg. *Historical Evidence of Ohio River Bank Erosion (*U.S. Army Corps of Engineers Louisville District, 1983), 81.

When he thought back to twenty years prior, he recalled "the grandeur and beauty of those almost uninhabited shores" with "lofty summits of the forests, that everywhere spread along the hills and overhung the margins of the stream, unmolested by the axe of the settler." The price of safe navigation of the river was the "blood of many worthy Virginians," particularly Native Americans. His critique did not stop there. The loss extended to specific portions of the ecosystem, such as the loss of "vast herds of Elk, Deer, and Buffaloes which once pastured on [these] hills." The several salt springs which attracted these animals had "ceased to exist" as well. Audubon believed that the Ohio Valley experienced a "transplanting [of] civilization" and "instead of being in a state of nature, [was then] more or less covered with villages, farms, and towns, where the din of hammers and machinery is constantly heard; that the woods are fast disappearing under the axe by day, and the fire by night; that hundreds of steamboats are gliding to and fro, over the whole length of the majestic river, forcing commerce to take root and to prosper at every spot." The navigable river encouraged further resource extraction and industrial pursuit. The rapidity of the change did not escape Audubon: "I remember that these extraordinary changes have all taken place in the short period of twenty years, I pause, wonder, and although I know all to be a fact, can scarcely believe its reality."[54]

Audubon recognized that the Ohio Valley changed substantially as a whole, and river commerce was the driving force. How could it be that such a transformation would take place in such a short period? The answer lies in tracing the federal government's emphasis on maximum commercial and industrial growth, which Audubon observed. Audubon saw a clear distinction between what he saw a natural river and the contemporary state. This distinction and prioritizing

[54] As quoted in the Richard Rhodes, ed., *The Audubon Reader* (New York: Everyman's Library, 2006), 25-6.

influenced discussions regarding the purpose of the natural highway and the actions that followed to tame the river.

River navigators and observant sportsmen could not easily overlook the river changes and the ramifications of the engineers' projects. Even at the beginning of the alterations of the Ohio River, Audubon often lamented the quickly changing environment in his journals. On December 12, 1826, years before the intense efforts of the Army Corps of Engineers (Corps) to restructure the river, he wrote, "A century hence they will not be here as I see them, Nature will have been robbed of many brilliant charms, the rivers will be tormented and turned astray from their primitive courses."[55] He wished to capture the "noble Ohio" and the beauty of the valley "for the sake of future ages" in the written language before civilization caused their disappearance. Audubon's words were nearly prophetic and poignant.

Plans for Steamboats

The frequent mapping and surveying of the river from 1821 on was a critical first step in controlling the nature of the Ohio River for the modern state. Environmental historians, particularly those of conservation efforts in Africa, demonstrate that maps are a powerful tool that charts the areas humans find most valuable and creating borders. Maps, as a tool of science, inherently serve particular interests and project the interests of their creators.[56] As tools created by the state, they also increased the power of the state. With knowledge, the state was able to designate the "best" purpose and use of the land, but it was also an exercise of power.[57] The Ohio

[55] Maria R. Audubon, *Audubon and His Journals*, Vol. 1 (New York: Charles Scriber's Sons, 1897), 183.
[56] Dennis Wood, *Rethinking the Power of Maps* (New York: The Guilford Press, 2010).
[57] Maano Ramutsindela, ed. *Cartographies of Nature: How Nature Conservation Animates Borders* (Cambridge Scholars Publishing: 2014).

River surveys were not any different; they collected information for engineers to alter the river and projected the goal of improving navigation into the plans.

The clearing of the river removed natural shelters for river inhabitants in the sunken trees and vegetation on the riverbed. Birds that relied on the islands and sandbars for resting were left to find new areas. For fish, the continuous act of dredging in the river was probably the most serious change to the river, as it disturbed the gravel and rubble.[58] This practice had a significant impact on fish spawning in the Ohio. The act of dredging removed oxygen from the water, effected the river's nitrogen cycle, and physically disrupted spawning sites.[59] Beyond this effect on fish and other aquatic animals, gravel extraction through dredging has proven to cause further river bed erosion and exaggerates downstream flooding, a problem the Ohio Valley also faced.[60] The idea of a clear, navigable water highway transformed the Ohio River.

River guides mark this apparent shift in mentality and prioritizing of the more modern steamboat. Before the 1820s, river guides such as *The Navigator*, compiled by Zadock Cramer, were geared towards the flatboats and keelboats and emphasized the Ohio River's features. Over

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[58] W.D. Pearson and B. J. Pearson, "Fishes of the Ohio River," The Ohio River, *The Ohio Journal of Science*, Vol. 89, No.5 (1989), 184.

[59] Don Hopey, "Deep Questions Arise About River Dredging Scooping Up Sand, Gravel, and Rock from the Beds of the District's Rivers and Navigation and Provides Valuable Building Materials. It also Damages the Riverbed Environment." *Pittsburgh Post-Gazette* (Pittsburgh, PA), June 23. 1997; Jonathan Adam Freedman, "Dams, Dredging and Darters: Effects of Anthropogenic Disturbances on Benthic Fish Ecology," (PhD diss., Pennsylvania State University, 2010); Lian dong Jing, Chen xi Wu, Jian tong Liu, Hua guang Wang, and Hong yi Ao, "The effects of dredging on nitrogen balance in sediment-water microcosms and implications to dredging projects," *Ecological Engineering*, Vol, 52, March 2013, 167-174; Jagjit Kaur, Gopi Jaligama, Joseph F. Atkinson, Joseph V. DePinto and Adrienne D. Nemura, "Modeling Dissolved Oxygen in a Dredged Lake Erie Tributary," J*ournal of Great Lakes Research,* Vol. 33, 62-82.

[60] Jordan White, Ali Van Baars, and Adam Elias, "Riverbed Gravel Removal," (James M. Jefford Center's Vermont Legislative Research Service, The University of Vermont, 2012).

this decade and the 1830s, however, river guides began including more information on the Mississippi and started catering more to the navigational needs of steamboats.[61]

Navigators' guides provide insight into the commercial views of, and goals for, the river. At the beginning of the nineteenth century, most river travel required the use of flatboats or keelboats. These were rectangular, flat-bottomed boats that easily transported heavy freight in the shallow waters of the Ohio River. Six to ten crewmen moved the boat upstream, if necessary, with poles, but mostly these boats traveled downstream with the assistance of wind and river currents. Such boats, under favorable water conditions, could travel from Cincinnati to New Orleans in a couple of months. Farmers would even build basic, cheap boats to only travel downstream to New Orleans' markets, dismantle them, and travel north again on land. The only other option was to board a large boat and take the journey around the Gulf and up the Atlantic. The style of boats, thus, was designed with the living river, with its seasonal variance, snags, and islands, in mind.[62] However, the invention of steamboats drastically changed the relationship between boats and the river.

Steamboats promised to revolutionize river travel and, therefore, expectations of the Ohio River. However, this revolution was not instantaneous as the river could not support most of the large steamboats. The promise could only be fulfilled with changes to the Ohio River. In 1811, Robert Fulton's *New Orleans*, the first steamboat to travel on the Ohio River, demonstrated that

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[61] M'Lissa Kesterman, "American River Guides from 1800 to 1860," *AB* July 27, 1998. Cincinnati Museum Center Library and Archives; Note on river depth requirements: Steamboats had deeper hulls, were more massive, and generally transported heavier loads. All of these factors required more water depth in the river. Six inches of water could make the difference in whether or not a boat would successfully stay afloat.

[62] Archer Butler Hulbert, *The Ohio River: A Course of Empire* (1906); T.W. Records, "Flatboats," *Indiana Magazine of History* 42 (1946), 323-342; James Mark and Gary M. Walton, "The Persistence of Old Technologies: The Case of Flatboats," *The Journal of Economic History* 33 (1973), 444-451.

humans could manipulate nature, steam in this case, with technology to ease the work of navigation. Pilot Zadock Cramer commented in his 1811 guide, "it will be a novel sight… to see a huge boat working her way up to windings of the Ohio, without the appearance of sail, oar, pole, or any manual labor about her."[63] Such sights were widespread in the Ohio Valley. However, the condition of the Ohio River in the early nineteenth century did not permit this steamboat navigation with the ease that Cramer and others predicted. Instead, the boats praised in the deeper Hudson and Delaware Rivers for traveling at the rate of four miles an hour against the wind and tide, struggled to navigate the seasonably and geographically variable Ohio.[64] The risk of being held up by low water limited commerce to the season with relatively predictable freshets, or river rises: the spring, commonly referred to as the "coal rise" in the mid-1800s (February to April), and the fall (October to early December).[65]

Due to the persistent threat of low water, during the first quarter of the nineteenth-century keelboats still carried the majority of goods, although technological innovation had brought the possibility of much larger boats. Once the river rose, barges carried the heavier goods, such as coal, lumber, and crude iron, downstream but they would sit in the Pittsburgh harbors waiting for such an opportunity that sometimes would never come.[66] 1819 was a particularly bad year for drought, rendering the river closed to steamboats from April 1819 to February of 1820. One newspaper reported in August,

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[63] Cramer, 32.
[64] William Eckman Kreisle, "Development of the Ohio River for Navigation, 1825- 1925," Master's Thesis, University of Louisville, 1971.
[65] Cramer, 34-6; Louis C. Hunter, *Studies in the Economic History of the Ohio Valley: Seasonal Aspects of Industrial and Commerce Before the Age of Big Business and the Beginnings of Industrial Combination* (Northampton, Mass: Smith College, 1934); "Coal Rise" note: Kreisle, 106
[66] Kreisle, 26.

> Hardly has a boat of any kind passed this place since the latter end of May. Several steam-boats have been lying between here [Shawneetown] and the mouth of the River all summer- some nearly or quite out of the water, others barely afloat. It is astonishing to think that the Ohio, one of the largest rivers in the world- the Ohio whose swollen waters some short months ago presented a current of fifteen hundred miles in length, and from one to ten in width, and whose depths were almost unfathomable, should now be (comparatively) a small stream, fordable in many places and literally seeking its way over pebbles.[67]

Such drought was economically devastating to not only steamboat crews and travelers but also to the farmers who heavily relied on credit and needed to "pray for his produce" on the way to market.[68] In January, one Cincinnatian reported to a newspaper following the Ohio drought story that "the farmer looks forward to the approaching spring with fearful apprehension, as he can have but little or no prospect for small gains."[69] The lack of trade also drove up prices for the produce and goods that managed to find other means to market.

Responding to the impact of this drought and the growing importance of the steamboat and the river as settlements moved west, representatives from Virginia, Kentucky, Pennsylvania and Ohio met in Pittsburgh in 1819 to make plans that would encourage river improvements. During this meeting, they mapped out 102 obstructions, such as snags and sandbars, between the cities of Pittsburgh and Louisville.[70] After battles over the legitimacy of the government to "undertake internal improvement for purely commercial purposes," Congress approved $5,000 in funds during 1820 for the surveying the Ohio and Mississippi Rivers under the justification of

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[67] "The Ohio River," *Connecticut Courant*, September 21, 1819, 3. ProQuest Historical Newspapers.
[68] "The Ohio River," *Connecticut Courant*, September 21, 1819, 3. ProQuest Historical Newspapers.
[69] "Ohio Drought," *Connecticut Courant*, January 21, 1820, 3. ProQuest Historical Newspapers.
[70] Sherman L. Frost and William J. Mitsch, "Resource Development and Conservation History Along the Ohio River," *The Journal of Science*, v. 89, no. 5 (1989), 145; "Pennsylvania Legislature, Report of Commissioners, on a view of the obstructions of the river Ohio," *Pittsburgh Weekly Gazette* (Pittsburgh, PA), December 28, 1819.

military and "post-road" powers.[71] Captains H. Young and W.T. Poussin of the Topographic Engineers and Lieutenant S. Tuttle of the Corps of Engineers began the three-month surveying in 1821. The results presented to President James Monroe the following year compared the Ohio to the Loire River in France and recommended the implementation of low dikes and the clearing of the river channel.[72] The 1820s, thus, marked the beginning of federal efforts to improve the Ohio River.

The major obstacle to navigation, and therefore growth, was finding a permanent solution for the seasonal variability of the water's level. As early as 1811, Zadock Cramer, a famous author of one of the earliest American river guides, warned his readers of the difficulties associated with low water, especially for large vessels,

> In times of high water, vessels of 400 tons burden can descend with ease, except the difficulty arising from managing so unwieldy a bulk at the points and islands and short turns in the channel of the river. Vessels of this tonnage have descended from Pittsburgh to Orleans in safety, but the chance of good water renders the undertaking a little hazardous.[73]

Safety of the crew, and their goods, was a legitimate concern; boats were often "lost" while traveling down the Ohio. While some accidents may be attributable to poor craftsmanship in boat building, pilots often blamed accidents on low water and the exposure of hazardous rocks and sandbars that would not be as problematic during higher water.[74] For economic reasons, many invested in the Ohio River Valley clamored for "opening the navigation of the Ohio," framing their arguments in nationalistic terms and progressive ideals[75]

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[71] William F. Gephart, "Transportation and Industrial Development in the Middle West," (doctoral thesis, Columbia University, 1909), 215.
[72] Kreisle, 59-60.
[73] Zadock Cramer, *The Navigator, 7th Edition*. (Pittsburgh: Cramer, Spear & Eichbaum, 1811), 26.
[74] Cramer, 33-4.
[75] Cramer, 27.

The Ohio River appeared to nineteenth-century contemporaries as an obvious source of wealth to exploit. Zadock Cramer, an author of river guides, claimed, "Indeed, the very appearance of the placid and unbroken surface of the Ohio invite to trade and enterprise."[76] The idea of a regulated river, in which humans artificially controlled the water level for the desired height year-round, would guide engineers' actions throughout the nineteenth and twentieth centuries. The Army Corps of Engineers chose to focus on low-water control works that would permanently raise the level of the water to address the shallowness that plagued the river more often than flooding and posed an impediment to commerce and general navigation. As investment and confidence grew in the Corps of Engineers' alterations of the Ohio River, eventually the government would implement flood control measures on the river. As humans built more railroads and canals in the Ohio Valley, beginning in the 1820s, they expected to maximize the commercial efficiency of the waterway. Its trees, islands, and winding path were obstacles that needed to be overcome to realize the river's full potential.

One of the first significant ways to make the Ohio River more navigable for new steamboats was removing the sunken trees that more modern boats with deep hulls struggled to overpass. Through the 1824 Federal General Survey Act, Congress granted the U.S. Army Corps of Engineers authority over navigational studies, and the federal government increasingly became involved in Ohio River improvements.[77] The first Rivers and Harbors Act passed in 1827 and the Army Corps of Engineers began removal of all trees, limbs, roots of trees, and logs, commonly referred to as planters, sawyers, and snags.[78] An efficient and well-designed

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[76] Cramer, 32.
[77] Frost & Mitsch, 146.
[78] Rationale for the various terminology, from Serial Set, House Doc. 35, 11. as quoted in Erik F. Haites, James Mak, and Gary M. Walton, *Western River Transportation: The Era of Early Internal Development, 1810-1860* (Baltimore: The John Hopkins Press, 1975), 90: "Of the trees

technology did not exist yet for doing so, however. Therefore, the U.S. Army opened up a competition for the best snag removal device, offering a $1,000 prize for the best design. A year later, "Uncle Sam's Toothpullers," the popular name for these snag-removal boats, were put to work removing obstructions on the Ohio.[79] Pilots praised these new boats for their ability to remove snags up to 75 tons. Engineers designed them with two hulls featuring an "iron-sheathed snag beam" that joined the two hulls. Engineers ran the boat towards the snag at full speed, forcing the obstruction out of the water. Then, the operators would drag the snag onto the boat and cut it into pieces. By 1837, under the leadership of snag boat inventor, Captain Henry M. Shreve, more than 3,000 snags were removed from the Ohio.[80]

Focused on the benefits of the snag removal, government and locals seemingly never considered the possibility of any detrimental effects to the river habitat from this practice. Nevertheless, sunken logs and trees served as crucial components of the river habitat. Insects and fish could settle within and around these "navigational obstructions," which instead of being referred to as "sunken trees" had become refashioned as "snags" and "sawyers" purely based on their danger to boats. While systematically removing these small habitats, engineers began

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which are in this way precipitated into the river, some are borne off by the stream, some are lodged upon the shores, where they form 'rafts,' obstructing the navigation of certain 'branches,' and require to be avoided with great care… Others of these trees become fixed in the bed of the river. When so fixed as to preserve an immoveable position, they are called 'planters;' but when, being inclined from the vertical, and pressed upon the current, they move in regular or rather in uninterrupted oscillations, they are called 'sawyers;' 'snags' is a term applied to either."

[79] Leland Johnson. *The Davis Island Lock and Dam, 1870- 1922*. (Pittsburgh: U.S. Army Engineer District, 1985).

[80] Ambler, 317; "Engraving of Steam Snag Boat A.H. Sevier," On the Water, Smithsonian National Museum of American History, amhistory.si.edu/onthewater/collection/TR_336779.html.

selecting for species that did not depend on driftwood and tree trunks for shelter.[81] In this way, the engineers decreased biodiversity within the river. Limnology, the study of inland waters, rose after these early alterations, later in the nineteenth century, and so scientific interest in the habitats of fish was not adequately developed during this period to begin making these connections.

In addition, snag-removal was addressing a symptom, not the cause, of the Ohio River's problems. The Ohio faced a more extensive historical issue of erosion. Historian Louis Hunter asserts that the prevention of snags was "as important as [a] cure" of physically removing the snags in the entire river. The erosion of tree-lined banks was recognized as a principal cause of snag formation."[82] The natural flow of the water, accentuated by the engineers' projects, allowed for the riverbanks to cave in and caused the trees to fall in the river in the first place.[83]

Control Through Early River Engineering

Simultaneous to efforts to remove trees in the river, navigators also sought to overcome the obstructions of sandbars and large rocks. In 1830, Captain Shreve led the removal of reefs near the mouth of the Ohio River at the Grand Chain of Rocks between Paducah, Kentucky and Cairo, Illinois. These formations made the river so shallow that squirrels hopped across the water via the rocks. The Army Corps of Engineers removed over 3,000 tons of rocks from the channel to clear this portion of the river for navigation.[84]

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[81] G. Mathias Kondolk, Matt Smeltzer, and Lisa Kimball, *Freshwater Gravel Mining and Dredging Issues* (Berkeley, CA: Center for Environmental Design Research, 2001), 8-10. <wdfw.wa.gov/publications/00056/wdfw00056.pdf>
[82] Louis C. Hunter, *Steamboats on the Western Rivers: An Economic and Technological History (Cambridge: Harvard University Press, 1949), 181, 192-198, 235-6, 272-5.*
[83] Michael P. Marchioni, "Economic Development and Settlement Patterns in the Flood Plain of the Upper Ohio Valley with Special Reference Given to Flood Damage Reach 11 Pt. Pleasant, West Virginia to Marietta, Ohio," dissertation, University of Cincinnati, 1971, 109-110.
[84] Kreisle, 67.

The main troubling question was more complicated than removing trees and rocks: how could they prevent the build-up of silt that worked against a consistent, reliable and deep level of water that would allow steamboats to travel the river year-round? The first major federal project to deepen the shallow sections of the river resulted from the 1822 government survey report recommending the installation of dikes. Building permanent structures was not a novel idea, as George Richard Butler suggested the placement of stone dikes nearly four decades prior, in 1785.[85] However, the idea took on new life in the 1820s. Wing dams, or dikes, as written in a letter from the Citizens of Cincinnati, ideally "confined the current within narrow banks, and to give it a sufficient volume of water to wash a current for itself."[86] This technological innovation, in other words, channeled but did not replace natural processes; it was meant to increase the velocity of the river current and keep silt moving, rather than slowing down and settling in the bed. Strategically placed finger-like projections into the river's course, wing dams complemented the naturally created "succession of navigable pools" provided by sandbars during low water.[87]

In May 1824, Congress appropriated $75,000 for the installation of wing dams and the removal of snags. The Army Corps gave President Monroe the choice of two of the following six problematic sandbars in the Ohio River for this work: Flint Island, Kentucky; French Island, Kentucky; Henderson, Kentucky; Straight Island, Kentucky; Willow Island, West Virginia; and Lower Smithland, Illinois. Work began within the year at Henderson Bar, just below Henderson,

[85] Kreisle, 62.
[86] "Memorial of a Number of Citizens of Cincinnati" (1844), 30.
[87] Ibid.

Kentucky, under the Topographic Engineer Major Stephen Harriman Long.[88] The wing dam was considered an experiment, though, as the 1822 report mentioned:

> It is certain by the dikes and narrow passages the water may be deepened at any required point, but it is to be feared that in some places, at least, the locality may be such that the very materials thus carried off by the rapid waters may be deposited in such a way as soon to form a new bar below.[89]

Major Long was initially confident in the temporary success of the Henderson wing dam. By the 1830s, the Corps of Engineers began feeling relatively confident with the success of their projects. It built dams at Sisters Island (1831) and French and Cumberland Islands (1832) in Kentucky to create a three-foot channel.[90] By 1842, 111 wing and training dikes, as well as 47 back channel dikes, were at work on the Ohio, changing its ecology by transforming its flow.[91] Despite all of the efforts to make the Ohio River more navigable through the removal of materials, river depth was the center of focus for many. What good would an open waterway be without the water depth to safely carry boats downstream? Nevertheless, the federal government and engineers were unwilling to invest capital and time in the creation of other wing dams until time revealed the consequences and permanency of the wing dams in producing "the effect for which it was intended, viz. that of deepening the channel across the bar at all times of low water."[92] Time revealed that sand and silt continued to pile up around the wing dams. Therefore,

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[88] Kreisle, 62.
[89] Ibid.
[90] Kreisle, 68-9.
[91] R. R. Jones, *The Ohio River: Charts, Drawings, and Description of Features Affecting Navigation, War Department Rules and Regulations for the River and Its Tributaries, Navigable Depths and Tables of Distances for Tributaries* (Washington: Government Printing Office, 1922), 150; Kreisle, 76.
[92] "Letter from S. H. Long, Major Top. Engineers, January 12, 1826," Doc. No 145: Sand Bars of the Ohio, "Message from the President of the United States Transmitting the Information Required by a Resolution of the House of Representatives of the 21st Instant, in Relation to the Measures Which Have Been Taken to Improve the Navigation over the Sand Bars in the Ohio River; &c., &c., The Cincinnati Museum Center Library & Archives, Cincinnati, Ohio.

engineer's structures were unable to compete with the natural forces. The best solution, in the minds of Congressmen, was to continuously remove elements of the river, rather than try to prevent their creation, until the science behind rivers and technology improved.[93]

With the failure of wing dams, dredging of the river to remove silt and deepen the river channel was the next significant alteration to the river. As early as 1843, engineers used scrape boats on the Upper Ohio, in which the scraper dragged the river bottom to increase the depth of water.[94]

Dredges for waterways varied greatly. The various obstructions to navigation, materials, and soils that would be encountered by engineers led to a multitude of dredges, one for each type of job. Before beginning improvement on a section of the Ohio River, one would need to perform an extensive survey on the underwater landscape through a process of sounding. This survey would then provide a map of the river bottom that benefitted the work of both steamboat pilots and engineers alike.[95]

Once the western pilots recognized the navigational benefits of snag removal and dredging, residents of the Ohio Valley encouraged and further publicized the practice. Nevertheless, the rest of the nation largely pushed back on the constitutionality and legitimacy of the Ohio River projects. The funding for projects slowed due to President James Polk's use of the veto power on every waterways project that reached his desk.[96] Frustrated Ohio River

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[93] Ambler, 397.
[94] In 1878, the engineers also dredged the entire channel to create the first uniform depth of six feet; Louis C. Hunter, *Steamboats on the Western Rivers* (Cambridge, Mass: Harvard University Press, 1949), 223-4; Leland Johnson. *The Davis Island Lock and Dam, 1870- 1922*. (Pittsburgh: U.S. Army Engineer District, 1985).
[95] Charles Prelini, *Dredges and Dredging* (New York: D. Van Nostrand Company, 1912), 12.
[96] David Welky, *The Thousand- Year Flood: The Ohio- Mississippi Disaster of 1937* (Chicago: The University of Chicago Press, 2011), 15-16.

boatman began referring to snags as "Polk Stalks." The off and on-again approach to river improvements caused an uproar. Neighbors down south, in St. Louis, chose to send sections of "Polk Stalks," some six feet in length, to the White House.[97] Meanwhile, in 1844, arguing that the navigability of the Ohio "is not of local concern or sectional character," citizens of Cincinnati petitioned Congress "to expend a liberal portion of the public treasure in removing the obstructions."[98] Emphasizing the significant growth in settlement and industry that had occurred, Cincinnatians urged the federal government to continue funding the improvement of the Western river. The boosters noted in their pleas to Congress:

> It is impossible to consider these great arterial channels without perceiving their connexion [sic. connection] with each other, and tracing their ramification to the utmost extremities of our country. The West is no longer a frontier; it is the heart of the Union. This is not only geographically true, but it is true in every sense. The centre of population, of production, and of consumption is here. We furnish the greater portion of the exports and consume the greater portion of the imports that make up the sum of the foreign commerce of the nation. Our rivers are no longer margined by silent forests: cities, towns, villages, and cultivated fields, enliven their shores, and bear testimony to the industry, resources, and refinement of the country.[99]

Despite the plea, James Polk vetoed appropriations in 1846 for many American rivers, including the Ohio, on the grounds of that it was not within the federal government's scope to support state improvement projects.[100] Work on the river, such as the snag removal and building of wing dams would be put aside until 1867 when Congress approved river appropriations again.

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[97] W. H. Chandler. *The Evansville Journal* (Evansville, Indiana), September 24, 1846; "River News," *The Public Ledger* (Maysville, Kentucky), November 16, 1903.
[98] "Memorial of a Number of Citizens of Cincinnati, Ohio Praying the Removal of Obstructions in the Navigation of the Ohio and Mississippi Rivers," March 12, 1844, 28th Congress, 1st Session, Senate, 3-4.
[99] "Memorial of a Number of Citizens of Cincinnati, Ohio Praying the Removal of Obstructions in the Navigation of the Ohio and Mississippi Rivers," March 12, 1844, 28th Congress, 1st Session, Senate, 7. The Cincinnati Museum Center Library and Archives, Cincinnati, Ohio.
[100] Kreisle, 76; Paul F. Paskoff, "Politics: Polk and Post-Polk," *Troubled Waters: Steamboat Disasters, River Improvements and American Public Policy, 1821- 1860* (Baton Rouge: Louisiana State University Press, 2007), 64- 109.

Very much in the same manner as the 1819 low water, the halting drought of 1854 and subsequent “good” river year of 1855 brought navigational issues into the public eye again. The drought and its aftermath became yet another example of the Ohio’s natural tendencies hindering human enterprise. When the fall season rise did not occur, the effects on commerce were devastating. In September of 1854, the river reached the low water mark and no end of the summer drought was in sight. The *Cairo Times*, located in the lower end river, reported that "the river at this point has almost reached the low water mark- it will soon be so low as to be scarcely navigable with a shingle." Newspapers reported that the river became "nothing more than a string of frog ponds."[101] Men even switched to gathering boulders and coal from the Ohio riverbed itself to earn money.

Josiah Copley, a staff member of the *Pittsburgh Gazette* and writer for numerous religious presses, took great interest in the impacts of the failure of the Ohio to rise in the fall of 1854. He used the situation to pressure the Pittsburgh Board of Trade to find a solution to the river's low water. He used the example of the devastating 1854 season and the subsequent, fortunate 1855 rise to illustrate that Copley argued for overcoming the "periodical interruptions" brought on by low water with alterations to make the river "permanently navigable," much in the same way advocates had done in the previous decades. However, the region had grown significantly and increased its dependence on the river. Between the two major low water incidents, Pittsburgh had grown over 600%, with most of this growth in the previous decade, having double its population in less than ten years. He was sure to emphasize this central place of the river to the region but also the nation's economy, claiming "so vast is the exchange of commodification effected in whole or part through the medium of this river, that at least ten

[101] “Daily Crescent.” *The New Orleans Crescent* (New Orleans, Louisiana), September 19, 1854.

millions of the American people are directly interested in it; and the interests or more than eighteen millions would be favorably affected by say improvement that would render it a more reliable channel of trade." One type of trade that Copley concerned himself with was that of the coal industry, which had assumed a powerful role and convincingly claimed that the river was of "national" nature.

In response to the draught, three proposals for improving river navigation and addressing low water dominated: the creation of a system of artificial lakes, or reservoirs; a system of "slack-water navigation," involving a series of locks and dams; and a system of "pool and current navigation," consisting of dams and chutes.[102] The reservoir plan would have been essentially an application of a canal system to keep a constant flow of water in human-made canals, such as the Silver Creek Reservoir implemented in Schuylkill County, Pennsylvania. As the "Ohio River, technically considered, is merely a grand canal," a system such as this seemed to be an appropriate and logical solution for civil engineers.[103] Water would be collected in the artificial lakes during the wet seasons and then released into the river during dry periods.[104] This would benefit the valley in making use of the water rises.[105] Col. Charles Ellet Jr, a respected engineer who quickly became a jack of all trades, believed Americans could engineer their way out the flooding problem. Ellet calculated that three or four reservoirs would guarantee a river

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[102] Col. Ellwood Morris, C.E. *Treatise on the Improvement of the Ohio River*. Pottsville: Printed by Benjamin Bannan, 1857. *Google Documents*.
[103] Full quote: "For the Ohio River, technically considered, is merely a grand canal, 1000 miles long, and 1000 feet wide, with an average descent of half a foot to the mile, and it admits of being supplied with water by the same means as other canals, only proportioning those means properly to the magnitude of the case." (Morris, *Treatise on the Improvement of the Ohio River*, 6.)
[104] Kreisle, 107.
[105] "The Difficulty of Preventing the Ohio Floods," *Science,* Vol. 3, March 28, 1884: p.385-386.

depth of at least six feet "throughout every year" in his 1851 report entitled *Navigation of the Ohio and Other Rivers*.[106]

Col. Ellwood Morris, who wrote an article promoting this system, slightly modified Ellet's proposal. Morris claimed "it does not come within the scope of [his] paper to discuss the question" of flooding, but he did assert that the creation of six reservoirs along the Ohio would also "exert a material influence in moderating the Ohio River floods."[107] One benefit of the reservoir plan was that it would not add any obstructions to the river itself, as the other options planned to do.

Ellet's plan met considerable opposition from West Point graduate Captain Andrew Atkinson Humphreys, who effectively launched attacks against the plan. This would eventually lead to the prioritization of a plan proposed by W. Milnor Roberts, who would propose a plan of low dams in the late 1850s. Due to the success of experimental programs on the river's tributaries at the state level and expert advice of the Chief Engineer of the Corps' William E. Merrill, a slack water plan won the attention of engineers in the decades to come.

In the middle of the nineteenth century, the arrival of the railroad in the Ohio Valley initially led to less emphasis on alterations to the river for navigational convenience.[108] The railroads seemed to ensure the rapid, reliable, and uninterrupted transportation that merchants demanded, especially as demand for coal continued to rise.[109] Low water continued to be a frequent issue, costing merchants in the form of delays,[110] and the Louisville and Portland Canal

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[106] Welky, 16- 21
[107] Morris, 13.
[108] Vance, The Improvement of the Ohio River," *Annals of the American Academy of Political and Social* Science, Vol. 31, *American Waterways* (1908), 141.
[109] Ambler, 397.
[110] "The Low Water in the Ohio," *New York Times*, November 18, 1879: "The low stage of water has lasted nearly four months- a longer period than has been known within 20 years;" "Little

constructed in 1825 to avoid the Ohio River falls could not accommodate the new, larger and faster steamboats.[111] In addition, coal and towing companies opposed a lock and dam system because the locks required boats to disassemble a tow before passing through a lock, costing the steamboats time. It was unclear how truly beneficial river alterations would be to these interest groups, which had become used to an open river and the seasonality of river levels.[112]

By the late nineteenth century, though, regional concern grew from farmers that railroads were too monopolistic. Even the Populist National Farmer's Movement supported river improvements, believing that the revitalized competition would drive down the increasing railroad rates.[113] The first Ohio River dam, built in Pittsburgh, the Davis Island Lock and Dam, would be finished in 1885,[114] and in 1895, the creation of the Ohio Valley Improvement Association sought to revive interest in the river once more. Even as the Corps of Engineers performed their early work in the 1880s, though, technologies that river industries dependent developed and continued to increase in size. The Corps had to anticipate growth in all facets and not doing so could lead to a significant financial burden in the future. Otherwise, the initial investments would go to waste.

Eventually, representatives of the mining, manufacturing, commercial, and agricultural sectors agreed that the river must be altered and deepened once more to accommodate larger boats.[115] This further dredging would come in 1905, when Congress approved a new goal of

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Water in the Ohio River," *New York Times*, August 29, 1881, 5: "Navigation is virtually closed on the Ohio River."
[111] Ambler, 397.
[112] Kreisle, 125.
[113] Albert E. Cowdrey, "Pioneering Environmental Law: The Army Corps of Engineers and the Refuse Act," *Pacific Historical Review*, Vol. 44, No. 3 (Aug, 1975), 331-349.
[114] Kreisle, 127-9.
[115] Vance, 142.

nine-foot river depth. This work towards a nine-foot river channel that could compete with the railroad will be further explored in the next chapter.

With the aim of navigational improvement, engineers sanctioned by the local, state, and federal governments changed riparian habitats.[116] These engineers systematically removed important aspects of the river habitat, such as sunken trees and sandbars, with increasing speed. Some riparian species were more harmed than others by these actions. The darter was one such species whose decline can be partially explained by the removal of appropriate habitat. Then, they used technology to deepen the river through the use of dredges and placed permanent structures that artificially deepened the river, dividing the landscape.[117] By the middle of the nineteenth century, the larger western population and industry demanded and produced more goods. As a result, flatboats and keelboats fell out of favor, replaced by larger barges and steamboats. New boat preferences further encouraged additional river alterations to achieve a six-foot river depth, rather than the previous three and six-foot requirements.

The Corps of Engineers saw these "improvements" as encouraging the industrial and commercial success of the region and nation. The river became less associated with its natural aspects, and the Ohio River grew to resemble a large canal, artificial and virtually free of healthy aquatic life. The channelized river simplified the ecosystem of the river itself but the entire valley. For those who lived and worked in the region, the transformation did not go unnoticed.

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[116] It is estimated that over two million people settled in the 1840's alone: William Eckman Kreisle, "Development of the Ohio River for Navigation, 1825- 1925," Master's Thesis, University of Louisville, 1971, 78.

[117] Often, travelers and explorers in the late eighteenth and early nineteenth century noted the various animals, such as bears and deer, they saw crossing the Ohio River. With the current depth of at least nine feet, even if these species had not been pushed out of the habitats, it would be virtually impossible to fight the currents and depths to cross the river.

River navigators and observant sportsmen could not easily overlook the river changes and the ramifications of the engineers' projects. Even at the beginning of the alterations of the Ohio River, John James Audubon often lamented the quickly changing environment in his journals. The accuracy of Audubon's predictions is striking. At the end of the century, the Ohio Valley's wetlands were, indeed, essentially non-existent, and the Ohio River hardly resembled the one that flowed through the early nineteenth century. The sandy river banks turned into a muddy waterfront; the abundant supply of fish and mussels largely disappeared;[118] the relatively shallow, clear, flowing stream became a series of artificial, dark and cloudy pools of water; the numerous floating islands and sandbars were reduced; and the tamed river no longer exhibited extreme variability in the water levels. These changes were all set into motion by a mentality during the nineteenth century that river alterations were necessary for the growth of the expanding nation.

While the Ohio Valley grew as a commercial powerhouse, the new wealth would bring about the growth of industry. For instance, Cincinnati arose as center the pork packing, which also gave rise to several secondary industries, such as soap and candle making. However, the river itself and its fauna also inspired the creation of new markets. The progressive movement towards valuing the industrial interests of the Ohio River can be seen in the example of mussels industry that grew in the Ohio River during the nineteenth century. At the same time that the Ohio Valley began to make improvements to aid the usage of steamboats, industry sought to maximize efficient use of the river through extraction of its relatively worthless resources.

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[118] W.D. Pearson and B. J. Pearson, "Fishes of the Ohio River," *The Ohio River: Its History and Environment*, The Ohio Journal of Science, Vol. 89, No.5 (1989), 184; Ralph W. Taylor, "Changing Ohio River Mussel Populations," *The Ohio River: Its History and Environment*, The Ohio Journal of Science, Vol. 89, No. 5 (1989), 188.

Industries such as mussel harvesting solidified the view that the river was meant to be exploited and manipulated to accumulate wealth. The riparian environment had to adjust to the removal of its sandbars and the implementation of structures but to continuously produce for the removal of animals who assisted in maintaining a river. One a new view of the river as insignificant beyond commerce and industry took hold, momentum started to build to remake the river into an efficient machine. The investors in the river responded to every technological advance with new plans to increase the river's efficiency. With each alteration, though, humans became more responsible for and connection to the Ohio River, often in lasting and unforeseen ways by the end of the nineteenth century.

The re-engineered Ohio River ushered in a new status for the Ohio Valley as the nation's industrial and commercial powerhouse, but this new age also brought about a symbiotic relationship between the river and the nation's engineers. The new river depended on constant monitoring and dredging to maintain satisfactory consistency, as its previous ecosystem and natural processes depended on a very different river flow. As an ecological entity, the river was diminishing in value as it began to lose its biological diversity. Humans did access their water supply through the river in the nineteenth century, but they failed to make a connection between a healthy river and healthy communities. Rather, communities increasingly believed exploitation was the key to growth.

Humans would continue their alterations of the waterway in the years to come. Their economic survival depended on the new river; they successfully constructed a purely commercial water highway. Engineers created a new, modern river- regulated with a simplified ecosystem. By the late nineteenth century, this pure pursuit encouraged the generation of a new, increasingly

industrialized river, from its substrate to its riverbanks, by the final decades of the nineteenth century.

Chapter Two:

Building a River for Boats

In 1898, a steamboat pilot of the Ohio and Mississippi Rivers since the Civil War wrote of his experiences navigating the waterway over the previous forty years. Captain Sobieski Jolly expressed his dissatisfaction with the modern state of the river, as well as the federal projects and regulations underway. Jolly recognized that "the present generation of pilots derive many advantages from the assistance from the Government." For instance, government snag boats continued to remove snags and the Corps constructed and operated beacon lights. However, the pilot asserted that the dredging efforts had failed, as "work [that had] cease[d] at evening- by the next morning it will have filled up."[119] Rather than this constant work of manipulating the river and continuous government investment, Jolly asserted, "the best plan would be to build boats to suit the river and not ask the Government to build the river to suit boats."[120] Industry was growing substantially and required larger boats to increase shipping tonnage. Coal production and demands, in particular, required larger barges.

Many boat builders looked to the eastern United States for styles that allowed for transportation of bulkier goods, such as coal, but they required more depth of water than the Ohio often afforded. Some small companies, such as one in Tennessee that Jolly mentioned, continued to build boats "suitable for work near the whole year" on the river.[121] However, businessmen and politicians in the Ohio Valley overwhelming clamored for the federal government to invest more into the river, on top of the "thirty millions of money" already

[119] Captain Sobieski Jolly Papers (Jolly Papers), 1876-1898, Mss. 1046, Cincinnati Museum Center, 3.
[120] Jolly Papers, 3.
[121] Jolly Papers, 90.

supplied to the cause of river improvement. There was not a clear consensus of approval for the Army Corps of Engineer's alterations in the Ohio River that began with the Davis Island lock and dam in the previous decade. If old steamboat pilots were not universally in favor of the changes to the Ohio River, who did these alterations benefit by design?

Less than thirty years following Jolly's handwritten "Reminiscences of My Life as a Master and Pilot on the Ohio and Mississippi Rivers," President Herbert Hoover would stand in a park in Cincinnati, overlooking the Ohio River, and proclaim the river to be in a period of "Renaissance." The days of Jolly's prime, before the government's obstructions, thus were the implied "Dark Ages." The river had to be awakened, or re-born, for its former glory to shine through. The explanation for this drastic difference of opinion cannot be simply explained by the passage of time. Rather, these two men illustrate visions of the river that were often in conflict throughout the nation's expansion: a nation's river and a local valley's river. While the Ohio Valley businessmen benefitted economically from a new river, they lacked the manpower, expertise, and funding to make their vision a reality. The federal government, on the other hand, was organized and able to produce the necessary funding. Therefore, businessmen funded lobbying efforts in the nation's capital. Efforts to modernize the waterway increasingly brought the federal government's hand over the river and the entire valley. As one intervention was justified, such as checking the growth of the mussel industry or implementation of a lock and dam, it became increasingly easier to justify federal interventions in the future.

On the edge of the frontier, navigation was the Ohio River's primary purpose in the early and mid-nineteenth century. This view of the river continued through the early twentieth century despite the growth of railroad systems that had begun to replace commercial shipping in many parts of the country. The legislature inscribed this view into the federal government's plans and

law. Even as industry and population grew, residents, businessmen, and politicians continued to view other purposes as secondary. Federal interventions in the late nineteenth century and early twentieth would place the vision of a national inland waterway that would prop up the biggest Midwestern industry, initially coal and expanding to steel, above other visions. If the Valley wanted to compete, businessmen believed the Ohio River needed to have the long- sought-after consistency in a river that ecologically depended on season variability. The story of the Ohio River in the nineteenth century thus became a narrative of environmental exploitation and manipulation, backed by federal capital and programs, to support a growing nation.

The support of a navigable Ohio River had profound and lasting ecological consequences. Human values placed in commerce, westward expansion, and the general maximum exploitation of natural resources changed the riparian environment. The late 1800s and early 1900s signal a moment of change in the ecological and cultural relationship between the Ohio River and humans. While the river had an essential role in commerce, it was not generally considered vital to the industrial growth of the region, especially when railroads arrived. Railroad networks expanded over the course of the nineteenth century. While they altered the landscape, they also changed the commercial routes in the sense that humans were no longer restricted to the routes provided by the natural landscape. Engineers altered the landscape by cutting a new path and placing rail upon it. This created a new network, and aside from creating additional obstacles for river navigation in the form of bridges, the Ohio River was not a part of this new network. Looking to save money and hassle of needing to take their goods to the banks of the river, farmers and businessmen took advantage of the new networks. Railroads were also reliable and less vulnerable to seasonal changes. Therefore, Ohio Valley businessmen began to expect more of the waterway, wanting it to be just as reliable as the new railways. They sought

to control the river further and pushed to connect manufacturing to global markets, as the river was still connected to the water network. This push triggered significant changes in transportation technology, but this technology required the removal of many natural aspects of the Ohio River. Humans removed portions of the river's habitat in the decades before providing a clear path, but a new plan emerged to, in theory, permanently increase the reliability of the river to ensure consistent flow that would modernize the river in a manner that it could compete with the railway and global waterways. The river was to become a part of the nation's industrial network, despite the impacts on ecology. The long-term health of the river played no role in the decision making.

Building a new Ohio River for commerce and industry led to substantial changes to its flora and fauna. The nineteenth-century navigators' projects kicked off an expectation that humans should control the Ohio River, and therefore humans continued to manipulate water flow. However, many invertebrates depended on a variety of habitats within the waterway. Beyond the loss of mussels, alterations substantially reduced fish such as darters, paddlefish, sturgeon, sauger, and walleye. The change in water flow and loss of fauna would, of course, not affect all humans of the Ohio Valley equally. There is very little evidence to suggest nineteenth-century contemporaries took note of the changes other than recognizing growing sanitary problems and the inability to establish commercial fishing. However, representatives and engineers acknowledged the growing control of the federal government and its ability to determine the future of the river.

Towards the Heavily Engineered River

Between 1864 and 1866, the steamboat arrivals and departures in Cincinnati peaked and then rose to similar levels again in 1868 and 1869.[122] With the increased river traffic, support grew out of the previous efforts to make the river navigable, but the re-engineering of the river served specific industrial interests, such as coal, steel, and raw material transportation, rather than the general concern of the older generation. Most rivermen, Captain Jolly, for instance, learned how to accommodate the natural river. Railroads created an expectation that transportation should be like clockwork; one should know precisely when they will receive a shipment without much delay.[123] The river had too much seasonal variability for this expectation of predictability, but the railroads alone could not keep up with demand and began raising prices on freight. Ohio River traffic increasingly began to use the towboat and barge, which efficiently transported bulky commodities such as coal and corn.[124]

After the general failure of the wing dams to prevent sandbars, the Army Corps of Engineers focused on snag removal and dredging. However, grand plans from local businessmen, particularly in the interest of coal, for engineering a new Ohio River continued. In the antebellum period, the coal industry grew substantially and became an important component in America's industrial revolution. Mines increased but so did the demand for coal.[125] Businessmen began to form interest groups, such as the Ohio Valley Improvement Commission,

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[122] "To Clarence Ebgert, Private Security Director of the Geological Survey, April 13, 1883," Correspondence: Governor J. Proctor Knott, 1883-1886, Kentucky Department of Libraries and Archives (Frankfort, Kentucky).
[123] William Cronon's work discusses what railroads offered, and therefore, how they had the power and ability to alter the landscape of cities and their hinterlands; William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: W.W. Norton & Company, 1992).
[124] Daniel E. Bigham. *Towns and Villages of the Lower Ohio* (Lexington, Ky: University Press of Kentucky, 1998), 214.
[125] Sean Patrick Adams, "The US Coal Industry in the Nineteenth Century," Economic History Association. https://eh.net/encyclopedia/the-us-coal-industry-in-the-nineteenth-century-2/

to request that the government revisit the possibility of river engineering. River "improvement" projects sponsored by the federal government were not a new concept for the Ohio River. In the previous decades, the federal government assisted in the removal of snags and river islands, commonly referred to as obstructions rather than pieces of habitat. In the 1860s, the federal government started to become involved in engineering projects, and the Ohio Valley and nation were becoming more comfortable with it doing so. In 1867, the federal government acquired the Louisville and Portland canal. The Army Corps of Engineers quickly began to modernize the previously privately-owned canal by enlarging it and building new locks. Thus, U.S. citizens, laymen and businessmen alike, increasingly viewed the federal government as a dominant force in updating water transportation.[126]

In the late 1860s and 1870s, the old Ellet reservoir plan was still being considered, as well as a grand scheme to borrow water from the Great Lakes. Ellet proposed to turn the Ohio River into a canal by digging large reservoirs that would feed into the Ohio during periods of low water. This plan was expanded in another proposal to build a large pump that would bring water south from the Great Lakes to supply the Ohio River. Engineers deemed this "wild idea" as impossible through their surveys due to material and land costs. There was simply not enough land along the river for six large reservoirs, designed as twenty-five miles in length and one-hundred feet high.[127] Such a plan required a substantial slope, and the Corps estimated the initial investment at $625,000,000.[128] However, the idea and hope for a consistent river encouraged

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[126] Leland R. Johnson, *The Davis Lock and Dam, 1870-1922* (Pittsburgh: U.S. Army Engineer District, 1985).
[127] Kreisle, 113.
[128] George Turner Walch, "Navigation of the Ohio River and Its Tributaries," *Notes on some of the chief navigable rivers and canals in the United States and Canada, Made for the Government of Madras, During a Tour in 1876* (Madras: Lawrence Asylum Press, 1877), 43.

further inquiry. The Ohio River Improvement Commission, whose goal was to "adopt a permanent and liberal policy on the part of the National Government on the subject of the improvement of the navigation of this great channel of internal commerce [the Ohio-Mississippi system]," recognized the biggest issue, at least in the Upper Ohio, was "the want of water." This want was not just for a supply of water, but a consistent deep channel. The bars of the Ohio, reported the Commission, "keep cutting, and can't be controlled in natural channels." Moving channels were hazardous, as steamboat pilots could easily bank their boats if it had moved. The coal industry took a significant interest in fixing these issues.

After studying the Ohio River for three years, the Superintendent Engineer in charge of the Ohio River Improvement and founder of the Office of the Ohio River, W. Milnor Roberts, arrived at a very different plan. Roberts' plan was inspired by his colleague who assisted in the 1867 Ohio River survey and the Pennsylvania Canal, Alonzo Livermore. Livermore expanded on an Ohio Valley chute system already in place for mill dams on the steams in Kentucky. This chute system allowed flatboats to pass through chutes in dams rather than building a costly navigational lock. Livermore suggested cutting an opening in a dam, such as the Monongahela River dam, where a pool encouraged hundreds of coal barges to wait out low water. The opening could be closed using movable shutters. The downstream side of the dam would then be engineered to slope to assist boats.[129] Roberts ran with this concept and proposed a similar system along the Ohio River that would become known commonly as the "slack-water system." This slack-water river system was the answer only possible answer to modernizing the Ohio

[129] Johnson, *The Davis Lock and Dam, 1870-1922*, 15.

River by ensuring a depth of six feet and maximizing its potential to assist in commerce and industry.[130]

The Ohio Valley Improvement Commission, therefore, opted to support Robert's plan to turn the Ohio River into a reservoir through building dams at the proper intervals. As the Commission began to settle on this plant, the project hinged on one major question: how do engineers make it suitable for coal boats? In the late- nineteenth century, coal boats were steam-powered had a deep hull made of timber or steel. Towboats moved barges, flat-bottom boats made to carry bulky goods, by pushing them up and down the Ohio River.[131] To navigate, these coal barges needed river openings of at least 200 feet. Ideally, these boats would be able to navigate the entirety of the river system, from the eastern rivers to the southern-most point of the Mississippi River and back up the Atlantic coast, without ever needing to transfer goods between specialized boats.

The alternative reservoir system would not have placed obstructions into the riverway, but a slack-water system would create obstacles for large coal boats.[132] The potential for obstructions to navigation was problematic in a period of multiplying bridges already known to be an issue for boats, especially during high water stages. Such obstructions raised opposition

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[130] U.S. Congress, House of Representatives, Committee on Commerce, *Survey of the Ohio River: Letter from the Secretary of War*, 41st Cong., 3d session, 1871, Ex. Doc. 72, 1-2.
[131] "A History of Steamboats." U.S. Army Corps of Engineers. https://www.sam.usace.army.mil/Portals/46/docs/recreation/OP-CO/montgomery/pdfs/10thand11th/ahistoryofsteamboats.pdf
[132] "Ohio River Commission: Second Day's Proceedings." *The Cincinnati Enquirer* (Cincinnati, Ohio), September 20, 1872; "Bone, Evan- Interview and Memoir," 2. *The Oral History Collection of the University of Illinois at Springfield*.

amongst river navigators for any additional improvements to the river beyond additional lighthouses and navigational aids, such as buoys.[133]

William Milnor Roberts would not see the grand Ohio River plan through. He resigned from his position as U.S. Civil Engineer to accept a position of Chief Engineer with the Northern Pacific Railroad in 1870 and was replaced by Colonel William E. Merrill.[134] Merrill began his career by graduating at the head of his class at the West Point U.S. Military Academy in 1859. From there, he had many roles as a military engineer: constructing engineer, inductor, topographical engineer, command of an engineer regiment, and chief engineer of many projects. Most of this work dealt with railroad transportation. In June 1865, the Army Corps of Engineers sent him to relieve Lieut. Colonel James H. Simpson who was stationed in Cincinnati and therefore, he would be geographically close for the corps when Roberts retired.[135] He would have a hand in many projects from Tennessee to Missouri and remain in charge of the Ohio River for twenty-four years, leading to his nickname of "Father of the Ohio River Improvement."[136] His extensive experience with railroads was evident in his vision for a heavily engineered, predictable river and ability to argue for a national system.

Roberts' Ohio River plan generated excitement and hope in the valley. Like-minded civic leaders formed associations for a joint force that could effectively lobby the federal government

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[133] "Navigation Notes: Bridge Obstructions on the Ohio," *The Wheeling Daily Intelligencer* (Wheeling, WV), May 17, 1883.
[134] "An Obituary Notice of William Milnor Roberts." *Proceedings of the American Philosophical Society*, Vol. 20, No. 111 (1882), 201.
[135] *Report of Lieut. Col. James H. Simpson, Corps of Engineers, U.S.A., on the Change of Route West from Omaha, Nebraska Territory, Proposed by the Union Pacific Company, Made to Honorable James Harlan, Secretary of the Interior, September 18, 1865; with the President's Decision Thereon* (Washington: Government Printing Office, 1865), 22-23.
[136] "Col. W. E. Merrill: Biographical Sketch and General Order in Regard to His Death." *Green Bay Weekly Gazette* (Green Bay, Wisconsin), January 20, 1892; Johnson, *The Davis Lock and Dam, 1870-1922*, 17.

to expand its investment in the river, just as the federal government had done for the railways. Leaders from larges cities such as Pittsburgh, Cincinnati, and Louisville led the way with the Ohio River Improvement Convention (ORIC) in the 1870s. They often met to discuss and strategize on how to urge "the States bordering [the Ohio River] to use their endeavors to have such appropriations made" for the improvement of navigation."[137] Following the lead of the Mississippi River Improvement Convention that was created in 1867, ORIC participants on February 20, 1872, was made the convention official with the election of officers that represented the states bordering the river: Kentucky, Pennsylvania, West Virginia, Illinois, and Ohio.[138] Their president, former Senator Jesse D. Bright, spent most of his life in Madison, Indiana, and had relatively recently moved to Kentucky following his expulsion from his Indiana seat for sympathizing with the Confederacy. Bright owned extensive coal mines in West Virginia and was president of Raymond City Company from 1871 until his death in 1875. Therefore, in 1872, he appeared to be a powerful political force to represent the Ohio Valley river and coal interests.[139] The elected seven vice presidents were well-versed in other industries such as banking, insurance, steamboats, and iron. The convention had the economic interests of the Ohio Valley at the forefront of all of its decisions.

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[137] "Miscellaneous." *New Orleans Republican* (New Orleans, Louisiana), September 20, 1872.
[138] The Convention elected Jesse D. Bright (Kentucky) as President and John W. Chalfant (Pennsylvania), J. M. Camden (West Virginia), Captain R. H. Woolfolk (Louisville, KY), Thos. W. Means (Hanging Rock, Ohio), Jas. Howard (Indiana) and T. J. Shannon (Illinois) as Vice Presidents; "Cincinnati: Ohio Improvement Convention," *Pittsburgh Weekly Gazette* (Pittsburgh, Pennsylvania), February 21, 1872; Union Merchant's Exchange of St. Louis. *Proceedings of the River Improvement Convention, Held in St. Louis February 12 & 13, 1867* (St. Louis, Mo: George Knapp & Co., Printers and Binders, 1867).
[139] Charles B. Murphy, "The Political Career of Jesse D. Bright." *Indiana Historical Society Publications* 10 (1931); "Bright, Jesse David (1812-1875)," *Biographical Directory of the United States Congress*. Bioguide.congress.gov; "Mines of West Virginia," *National Republican* (Washington, D.C.), October 22, 1875.

The Ohio River Improvement Convention served as a go-between business and the federal government. One of its most significant tasks was addressing concerns that improvement would create more obstructions to fears concerning the role of government.[140] This concern was particularly an issue for coal which used larger boats than other industries and delayed the full support of the industry. The second most important task was justifying that the federal government should invest in improvements that would benefit private industry. In 1874, the Pittsburgh Committee on the Improvement of the Ohio River noted:

> "We have all seen the benefit of the improvement of our streets by the city authorities and we think the same rule that prevails in the case of streets should be applied to the Ohio River. If it is right for our city authorities to seize and enter upon property and convert it into a street for the general good, we can see no good reason why the United States should not enter upon and improve the Ohio river."[141]

In his address to the Convention, Engineer Milnor Roberts, former Corps Engineer, said that the government could complete very little work on locks and dams in the river due to the lack of support and funds.[142] This convention would shift the conversation away from merely removing obstructions, as had been the case through the 1860s, to revisiting old plans for actually utilizing engineering expertise to improve the river in its entirety as other countries had done.

By late 1872, the Convention explicitly appealed to Congress by addressing Ohio River improvement "as a national measure not as a local project." In its appeals for $2 million in appropriations for engineering surveys, the convention pointed out that over 35% of the US

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[140] Paul F. Paskoff, *Troubled Waters: Steamboat Disasters, River Improvements, and American Public Policy, 1821- 1860* (Baton Rouge: Louisiana State University Press, 2007), 109.
[141] "Ohio River Improvement," *The Pittsburgh Daily Commercial* (Pittsburgh, PA), December 15, 1874.
[142] "Cincinnati: Ohio Improvement Convention," *Pittsburgh Weekly Gazette* (Pittsburgh, PA), February 21, 1872.

population lived within the Ohio Valley and the area yielded over 40% of the nation's agricultural output.[143]

The approval of the coal trade was critical to lobbying for Ohio River appropriations. Pittsburgh's largest coal companies, known as the Pittsburgh Coal Exchange, demanded "that nothing shall be put on the Ohio that will any way interfere with the full and free use of the stream."[144] During the 1870s, the quantity of coal that passed through the Louisville canal, in the mid-stream of the river, was estimated to be anywhere from 75 to 100 million bushels.[145] Much of this coal, approximately 2.25 million bushels, went to New Orleans and approximately one million travelled to St. Louis, suggesting that the Coal Exchange had to think well beyond the valley and utilize boats that allowed for such long-distance travel.[146] With the plan of multiple dams and locks, the coal industry expressed concern that would lose their tows in needing to stop for dams. Colonel Merrill sympathized. Therefore, Merrill dedicated himself to learning more about coal-tows' experience through navigating on an Ohio River barge himself. He concluded that the trip down the river while loaded on a rise maybe longer with the stopping and going, but the year-round benefit was great in that boats going back up the Ohio would "lie by for months and months, scattered along the river until the next rise [took] them back to their harbour."[147]

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[143] "Ohio River Improvement: Pennsylvania Reservoirs- Why not Tap the Lakes, Dry up Niagara, and steal the St. Lawrence from Canada?," *Nashville Union and American* (Nashville, TN), November 22, 1872.
[144] The Pittsburgh Coal Exchange was a group of businessmen that formed in 1859 to lobby and work in the interests of the coal industry. By the 1870s, they were publishing regular reports to the newspapers. It created committees to deal with navigation issues, such as bridges and other engineering projects ("Bridging the Ohio: Proceedings in the United States Senate, Memorial of Committee of Pennsylvania Legislature, Report of the Pittsburgh Coal Exchange," *The Pittsburgh Commercial*, June 18, 1870; Walch, 43.
[145] Walch, 52.
[146] "Ohio River Improvement." *The Pittsburgh Commercial,* January 4, 1876.
[147] Walch, 44.

Just as plans were being proposed and finalized to transform the Ohio River, the buy-in from government stagnated. Congress reviewed the appropriations for the River and Harbor Bill every year, adding to the uncertainties. In 1870, the House Committee allowed for the allotment $500,000 in the following year to make the Ohio River more navigable. By 1873, though, Congress cut these funds to $300,000 and reduced it even further in 1874 to just half of that, $150,000.[148] Appropriations for Ohio River improvements were an ongoing fight during the 1870s. The work on the Ohio was susceptible to political swings, as Congress had to approve appropriations. Therefore, the comprehensive Ohio River project was quickly caught up in broader debates on federal appropriations and the role of government in improvements. Congressmen and businesses outside the region often made the argument that the river improvement benefitted the region rather than the nation as a whole, the project required constant lobbying to funnel federal money toward contracts. This issue held back construction of the first lock and dam, but it would continue to impede the progress of the slack-water plan until the early 1900s when Theodore Roosevelt's administration would revisit plans in his second term.

Merrill's Plan and the World's Large Lock and Dam

In 1874, Major Merrill put together an updated comprehensive report on the number and location of 68 locks and "wicket dams," featured by their movable gates, required to create slack-water navigation for the entire Ohio River. Merrill projected the cost of these to be just under $40 million; he noted, though, that delays and extra work were inevitable given the seasonable nature of the river and its tendency for sand to pile up in the bed. Nevertheless,

[148] "Statement Showing Amounts Appropriated Each Year from 1866 to 1874, Mis. Doc 103." Senate Documents, Vol. 271, 43rd Congress, 2nd Session, 1875).

Merrill argued that $41,365 worth of work per each mile was not "unreasonable" for improvement and that the government would consider "appropriation for its [the Ohio River] improvement at least equal to the sum that would be required to build a railroad of equal length."[149] The government was undoubtedly providing the railroad a leg up over river commerce, particularly after the completion of the first transcontinental railroad in 1869, and Merrill pointed out this governmental priority in his pleas to acquire more funds for Ohio River changes. While the government was investing substantially in railroads, it essentially abandoned the inland rivers to limited dredging, snag removal, and a few stone dikes, which directed the river current.[150]

Merrill's locks and dams projected at the sixty- eight locations across the length of the river that would provide and ensure the water depth of six feet. Lock and Dam No. 1 would be at Davis Island, approximately 4.7 miles downriver from Pittsburgh and No. 68 would finalize construction at the mouth of the Cache River, just upstream from Cairo, Illinois.[151] Based on this report, Congress approved the appropriation of $100,000 to begin construction of a wicket dam to test this method of improving the navigability of the Ohio River and its tributaries.[152]

This whole plan hinged on an experimental movable gate in each lock and dam. Merrill took an extended trip to France and carefully studied its inland waterways. He favored French engineers' "movable dams" successfully operating on the Seine, Yonne, Marne, and Meuse

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[149] Walch, 45.
[150] Walch, 45.
[151] R. R. Jones, *The Ohio River: Charts, Drawings, and Description of Features Affecting Navigation, War Department Rules and Regulations for the River and Its Tributaries, Navigable Depths and Tables of Distances for Tributaries* (Washington: Government Printing Office, 1916), 158.
[152] F. W. Altstaetter. "The Ohio River" *Professional Memoirs, Corps of Engineers, United States Army, and Engineer Department at Large*, Vol. 2, No. 5 (January- March 1910), 37.

Rivers. These dams featured a navigable pass, that as filled with narrow and movable wickets that could be raised or lowered at will. During high water, the wickets could be "thrown down," and the entire width of the water would be navigable. However, during low water, the wickets could be raised and create a safe, navigable pass. These dams allowed for predictability in navigation by raising or lowering individual dam wickets depending on the high or low flow of the river, in specific portions of the waterway, to maintain a reliable channel depth of six feet.[153] Locals observed the effects of such structures on the environment, but engineers continued to view them as the principle way to control rivers. Some scientists raised the possibility that the locks and dams would raise the water levels and exaggerate flooding of the river, but engineers adamantly denied this possibility.[154] Not only did these locks and dams raise the water level, but they also created pools of water that would concentrate fish for fishermen.

While France, Germany, Dutch East Indies, and locations in the eastern United States had used similar wicket dam gates on small rivers, the Ohio was much larger, and these gates were not "quite analogous" to what the Ohio required.[155] The lower portion of the Monongahela River, for example, had been “slack-water[ed]" and served as a nice point of reference for the Ohio River project. Before the Committee on Transportation, Colonel Merrill said, "The great

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[153] *Report of Lieut. Col. James H. Simpson, Corps of Engineers, U.S.A., on the Change of Route West from Omaha, Nebraska Territory, Proposed by the Union Pacific Company, Made to Honorable James Harlan, Secretary of the Interior, September 18, 1865; with the President’s Decision Thereon* (Washington: Government Printing Office, 1865), 22-23; Rick Rhodes, *The Ohio River In American History and Voyaging On Today’s River* (St. Petersburg, FL: Heron Island Guides, 2007), 45.

[154] W. Milnor Roberts, “Improvement of the Ohio River, Explanatory Remarks on the ‘Review of Ellwood Morris,” *Journal of the Franklin Institute* (Philadelphia: Journal of the Franklin Institute, 1857), 6. Hathi Trust: “In considering the additional rise to be caused by high floods in consequence of the proposed dams, Mr. Morris presses the theory that all floods will be augmented to the full extent of the height of water already in the river.”

[155] Walch, 44.

advantages of the slack-water are that it is simple… It is easily built; there are no excessive dangers, and it is at present in use on the Monongahela river, where it fully meets the wants of the very class of navigation which demands the improvement of the Ohio, and that is the coal-trade."[156]

Nevertheless, the Ohio was known for its tendency for sudden floods that well exceeded 25 feet in the Upper Ohio, and the gates would need to be adapted to avoid creating local floods but also ensure coal tows would be able to navigate without delay when slack-water was not necessary.[157] Therefore, Colonel Merrill proposed to Congress in 1874 that a trial lock featuring this gate be constructed. At the head of the Ohio River and close to the head of the coal industry, the Army Corps of Engineers determined Davis Island would become the location of Dam No. 1.

Popular and governmental opposition delayed construction on the Davis Island Lock and Dam until 1878. It would take seven years and 19 days, from 1878 to 1885, to complete the project to due foundation issues, flooding delays and repairs, new engineering problems and difficulty obtaining appropriations from Congress. This delay would lead to further delays in Ohio River improvements, as Colonel Merrill wanted to ensure he could adapt the most substantial navigation lock and Chanoine dam of the nineteenth century to the Ohio River's conditions. The biggest engineering problem involved the first steel bear-trap gates, which failed to rise after being placed, and led to the creation of a new weir. The Davis Island Lock and Dam would also serve as a testing site for revisions while engineers built the other dams and locks, such as replacing the wooden lock gates with steel gates in 1897 and new gate operating gearing

[156] Walch, 44.
[157] Jones, 158; J.W. Arras. "Locks and Movable Dams of the Ohio River: River Fluctuations." *Professional Memoirs, Corps of Engineers, United States Army, and Engineer Department at Large* 3, No. 12 (October- December 1911), 539.

and machinery that increased its strength. Practically all of the dam and lock's movable parts underwent significant modifications until the Davis Island dam's removal in 1922.[158] By the end of 1883, the Davis Island Dam project, which included a navigable pass, three weirs with wickets, and a fixed dam, was practically complete and was merely awaiting further governmental appropriations for completion in 1885. During low water periods, the workers raised the Davis Island dam, creating a pool that would extend upstream a couple of miles beyond the confluence to Herrs Island on the Allegheny and Dam No. 1 on the Monongahela River.[159] Davis Island has been touted as an engineering feat, having the largest lock in the world, and it inspired later engineering projects. Leland Johnson, Army Corps of Engineers historian, claimed, "Except in scale, the engineering achievements at Davis Island have not been surpassed in the 20th century."[160]

After the successful completion of the Davis Island Lock and Dam, the Corps of Engineers continued with plans of building locks and dams to help maintain the nine feet navigation system, referred to as the "canalization" of the Ohio River. [161] The hopes of economic benefit due "the completion of each lock and movable dam" were substantial "to every mine and factory of the valley:"

> The valley of the Ohio -- the very heart of the commercial and industrial life of the country- would not depend solely on railroads… To-day the merchant, the farmer, the manufacturer, and the miner find the value of their products at zero too often because of the inability of the railway to furnish him transportation to a market- for the value of the article of commerce is measured by its ability to reach a market. With the Ohio permanently improved, merchant and manufacturer, miner and farmer, would have ready

[158] The dam would be removed for the Emsworth Locks and Dams; Johnson, *The Davis Lock, and Dam, 1870-1922*, 3; Arras, 546-547
[159] Jones, R.R., The Ohio River Survey, 32.
[160] Johnson, *The Davis Lock and Dam, 1870-1922*, 3.
[161] Johnson, *The Davis Lock and Dam, 1870-1922*, vii.

> access at all seasons of the year to a market, and the consumer would profit none the less than the producer.[162]

The goal of this work, in other words, was two-fold. First, as with the earlier work, modernizing the river would allow larger boats, particularly the coal industry's towboats and barges, to navigate the river. Deepening the river and removing snags helped, but these projects did not ensure water depth that large boats needed. "Tonnage" became the primary measure of river work, and the river needed to support an increase in the tonnage traveling down the river. Second, engineering efforts would set the river up for future needs such as the potential generation of energy. Louisville was one such promising powerhouse, as it had a natural falls.

The concern for the engineers' productivity in efficiently completing this project can be viewed in the Corps' annual reports and local newspapers. Both took great interest in the project that promised to transform the river. Newspapers picked up a variety of material, from delays in work to a murder at the camp for the building of the Neville Island lock and dam.[163]

Although Merrill passed away in 1892, his vision for the engineered river continued. Only about two years into the Davis Island project, Congress authorized a second dam, followed by the approval of four others in 1896 to be constructed between Dam No. 1 (Davis Island) and Dam No. 6.[164] The construction continued downstream from the first dam at Davis Island to Beaver, Pennsylvania where the next lock and dam, No. 6, would be built from 1892 to 1904,

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[162] John L. Vance, "The Improvement of the Ohio River," *Annals of the American Academy of Political and Social* Science, Vol. 31, American Waterways (1908), 145; The flowing French rivers implemented the wicket dam: Seine, Marne, Yonne, and Meuse. (William E. Kriesle, "Development of the Ohio River for Navigation, 1825-1925," M.A. thesis, University of Louisville, 1971, 117-120).

[163] "A Deliberate Murder: Leslie Woods Killed at Neville Island Camp Yesterday." *The Pittsburgh Press*, October 20, 1898.

[164] J.E. Switzer, "The Completed Ohio River Project." *Proceedings of Indiana Academy of Science (1931)*, 340. Indiana State Library- Indiana Division.

followed by the commencement of many others in Pennsylvania. Plans changed slightly with new knowledge. Modifications to the dam and lock design, such as increasing the lift in the locks and shifting locations, reduced the number of necessary to 52.[165] For example, one lock (No. 42, between Louisville and Salt River) was eliminated from the revised plan of 54 lock and dams, as engineers discovered the arrangement of adjacent dams could be shifted a bit to ensure the nine-foot depth and rendering No. 42 unnecessary.[166] The plans for designing the new river were always in flux, and the locations of the dams were not based on local interests or environments as much as determining the least amount of infrastructure to ensure the six-foot, and eventually, nine-foot desired water depth during low water periods.

Engineers completed most of the work in groups as appropriations and the seasonality of the river permitted, roughly following the flow of the river and picking up speed in the later years of the project. Work substantially slowed after the government made no appropriations for the building of dams in 1897.[167] Seasonality and natural fluctuations in the river caused problems for cofferdams, which allowed the building of the permanent dams, and the ability to deliver necessary supplies. As a report by the Corps of Engineers explained, "when rises occur the work ceases; when winter approaches the earliest opportunity is seized to suspend operations; flood and breakage repairs are made at leisure, and so on… Abnormal freshets, ice, etc., are always urged as a sufficient cause for a liberal extension of the contract time limit."[168] River

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[165] Jones, 159.
[166] Jones, 6; *Sundry Civil Bill, 1917: Hearings Before Subcommittee of House Committee on Appropriations, Part 1* (Washington: Government Printing Office, 1916), 444. Google Books.
[167] For Rivers and Buildings." *Pittsburgh Daily Post* (February 12, 1897).
[168] J.W. Arras. *Locks and Moveable Dams of the Ohio River. Professional Memoirs, Corps of Engineers United States Army, and Engineer Department at Large*, Vol. 3, 12 (October-December 1911), 538.

fluctuations, ice, accumulation of drift,[169]breakages, and renewals all significantly affected the progress of engineers on the river but also in the day-to-day operations of the locks. Ice was particularly dangerous for the dams, as it can build up on the dams and destroy them.[170] In this way, the pre-engineered, natural cycle of the Ohio River required humans to respond consistently. Its character pushed back against humans' plans to make the river's yearly cadence obsolete.

Doubt in the Corps of Engineers existed even into the 1900s, despite the continuation of projects. While the "account of work on the Ohio River seems a narrative of simple and placid progress of events," Engineer F. W. Alstaetter points out that engineers who proposed and carried out work on the Ohio were "opposed at every point by contrary ideas. They have been accused of lack of knowledge, of lack of interest, of opposition to progress, [and] of failure to appreciate the needs of the river." Alstaetter was even accused of being a "horrible example of the petrified conservation of the Corps of Engineers."[171] While the government granted the Corps of Engineers' vision of the river priority, it is clear that there was not a single vision for the river. Thus, the slack-watered Ohio is also a story of prioritizing a vision -- that of a national serving transportation artery -- above all others.

The federal government had the authority to create dams on the Ohio River due to environmental and property concerns and codified this authority through the Rivers and Harbors Act of 1899. This act made it illegal for anyone to dam a navigable stream, such as the Ohio, or

[169] Drift includes everything from large trees, logs, timber, barrels, boxes, keys, bales of hay and straw, small twigs, and anything that could find its way into the bodies of water and flow into the main channel.
[170] Arras, 544.
[171] Alstaetter, 37-38.

to dump refuse into said streams without a permit from Congress.[172] Many local pilots were critical of this act, as it also applied to hydroelectric dams and concentrated power within the hands of a few large utility company owners. Contemporaries were also concerned that the act would cost many jobs once the federal building of river infrastructure ceased as "improvements" could no longer be made by private industries.[173] Not only was the government assuming more power over local landscapes, but that power was increasingly concentrated.

Final Push to Finish the New River

With the significant push for the improvement of rivers and the growing realization that the railroads were insufficient for moving food and industrial output, President Theodore Roosevelt's Secretary of State, Elihu Root, announced to Congress in December 1907 that the country has "come to a point where the railroads of the country are unable to perform that function which is necessary to continued progress in the increase of our national wealth… the one avenue that is open for us to keep up our progress is the avenue of water transportation."[174] The "monopolistic greed" of railroads, as U.S. Senator George E. Chamberlain of Oregon would say, had to be controlled through "more stringent laws" but through the "the proper use of water transportation".[175] In line with Roosevelt's anti-monopoly campaign, the administration and Congress were ready to commit themselves to addressing industry's growing frustrations with the

[172] Diane D. Eames, "The Refuse Act of 1899: Its Scope and Role in Control of Water Pollution," *California Law Review*, Vol. 58, No. 6 (Nov. 1970), 1444-1473.
[173] Jolly, 84.
[174] Douglas A. Brown, *Proceedings of the National Rivers and Harbors Congress: Sixth Annual Convention, Washington, D.C., December 8, 9, 10, 1909* (Cincinnati: The Ebbert & Richardson Company, 1910), 59.
[175] Brown, 54.

railroads by improving inland waters.[176] Federal focus returned to the Ohio River as a diversifying measure.

In 1907, President Roosevelt appointed the Inland Waterways Commission, chaired by Ohio Representative Theodore Burton. In the previous Congress, Burton had been the chairman of the Rivers and Harbors Committee and now was in charge of preparing a comprehensive plan for the improvement and control of the United States' river systems. He asked Chief of Engineers of the Army General Alexander MacKenzie; Director of the U.S. Reclamation Service J.H. Newell; Chief U.S. Forester Gifford Pinchot; Commissioner of Corporations Herbert Knox Smith; and Former President of the National Geographic Society W. J. McGee to join his commission.

Roosevelt did not want this new Commission to be an outgrowth of the Rivers and Harbors Committee. Instead, he wanted it to think of rivers differently. Roosevelt's letter concerning this new committee noted that previous river works undertook a single purpose such as navigation, power, irrigation, flood mitigation, or water supply but "the time has come for merging local projects and uses of the inland waters in a comprehensive plan designed for the

[176] In 1906, the railroad underwent a crisis period due to rising prices, congestion, and delay on the lines. Railroad rates were also somewhat unpredictable; the federal government sought to fix this issue with the Hepburn Act, which gave the Interstate Commerce Commission the power to determine and set minimum railroad rates. While Americans would be against the government ownership of railroads, regulation did benefit citizens and, therefore, controlling private business through regulation was justifiable. [Brown, 34.] Despite the regulation, faith in the railroads was quickly eroding. The government made the railroads by aiding private investors; perhaps, it could make an alternative to railroads as well. [Gabriel Kolko, *Railroads and Regulation, 1877-1916* (Princeton: Princeton University Press, 1965); The American Rolling Mill Company, *River Shipping and Industry: A Compilation of Historical and River Shipping Data on the Ohio River and Its Tributaries* (Middletown, OH: The American Rolling Mill Company, 1923), 9. Public Library of Cincinnati and Hamilton County- Inland Rivers Library.]

benefit of the entire country." [177] He wanted the Ohio and Mississippi system to service the entire nation, and, as so many had done before him, he justified this expense by citing that the government already invested substantially in railroads. The Ohio River was part of a more extensive system of waterways that, in his mind, were all directly connected with the interests of the nation.

Interest in improving waterways did not die at the end of Roosevelt's presidency. At the Fifth Annual Convention of the National Rivers and Harbors Congress in December 1909, there was a great sense that the country was more ready than ever to transform all of its waterways. The government was already developing the Columbia River and many streams in Texas for the "higher" purpose of hydroelectricity. "Now, it is well that there is in almost every part of the country a project of that sort," said the recently elected and native Cincinnatian, President William Howard Taft.[178]

With the project already twenty-seven years in progress, the Corps of Engineers had only completed six contiguous dams on the Ohio River at the time of this unofficial body's meeting, and the attendees sought to speed up construction.[179] Congressional Representative John Dalzell, of Pennsylvanian, and delegate of the Ohio River Improvement Association, was mainly concerned with this delay. Dalzell called the delay a waste of resources, as transportation was in a moment of crisis and need of urgent attention.[180]

The Ohio Valley grew substantially since the proposals of the 1870s and Merrill's engineering work. The population of the valley nearly doubled from 11.5 million in 1870 to 22.5

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[177] "Water Ways Commission Is Appointed by President Roosevelt," *The Twice-A-Week Messenger* (Owensboro, Kentucky), March 20, 1907.
[178] Brown, 11-12.
[179] Brown, 67, 80.
[180] Brown, 80-82, 84.

million in 1909. The coal mines' production also increased, from just 16 million tons in 1870 to over 280 million tons in 1908; this accounted for 59% of the nation's total coal production. The Ohio Valley remained valuable concerning agricultural products, representing 28% of the total U.S. farms. In this sense, the Valley had significant pull in Congress and it easier than ever to gain the support needed to swing federal investment in the region.[181]

In 1910, the federal government finalized the plans for the Ohio River with the River and Harbors Act that included a comprehensive plan of improving the Ohio River to a depth of nine feet, rather than the previous aim of six feet.[182] With so much delay of the past, this act projected the remaining construction to require another 12 years. Therefore, little time went by before engineers proceeded on the remaining 48 projected locks and dams. Engineers broke ground for several dams in 1911 alone: Dam Nos. 12 (Wheeling, WV), 14 (Woodland, WV), 15 (New Martinsville, WV), 20 (Belleville, WV) 28 (Huntington, WV) 29 (Cattlesburg, KY), and 41 (Louisville, KY).[183] By 1916, when the government published its latest Ohio River study, the Ohio maintained a depth of nine feet throughout the year up through Dam No. 11, located near Wellsburg, West Virginia.[184] While the entire system was not complete, the ability to create artificial rises in the river proved useful during World War I, when demand for coal was high and the nation's rail system was in crisis. This critical need also created a demand to finish the lock

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[181] Brown, 82.
[182] Switzer, 340.
[183] *Light's Golden Jubilee; Ohio River Celebration*, 32-33. Heinz History Center (Pittsburgh, PA); Chief of Engineers. *War Department Annual Reports, 1912,* 2 (Washington: Government Printing Office, 1912), 1278.
[184] In 1916, 16 dams in operation including: 1- 11, 13, 18, 26, 28, and 37; 18 were under construction: 12, 14-17, 19-24, 29, 31, 33, 35, 39, 41, 43, 48; and 19 were not yet provided for: 23,25, 27, 30, 32, 34, 36, 28, 40 ,44-47, 49-41; Jones, 1- 7.

and dam at New Richmond.[185] Eventually, in 1922, the Davis Island lock and dam was dismantled and replaced by the Emsworth Lock and Dam, one mile from the original site. By 1928, fifty-one locks and dams were practically completed, meaning the river was able to maintain a nine-foot depth throughout the year and throughout the length of the river.[186]

Dam No. 41, constructed in 1926-1927 at Louisville, was exceptional and differed from the others. It was created to maximize the falls and generate power by the Louisville Hydro-electric Power Company. It included eight turbines and in 1929 produced 218,079,810 kilowatt hours. The Louisville Hydro-electric Power Company leased waterpower rights from the government for $95,000 annually, generating a return on the government's investment.[187] However, the Louisville dam demonstrated a shift in focus on the Ohio River. While the initial goal of the investments was to boost commercial navigation, hopes for engineering on the Ohio towards the end of the slack-water project grew beyond this to actual generation of energy for the Valley.[188] With plans underway to construct dams in the western United States for power generation, this shift in focus is fitting.

The locks and dams presented problems for pilots on the riverway after they were completed, but also while they were under construction. Vernon Byrnside, who worked on towboats for over fifty years, served as a deckhand aboard the Str. Eugene Dana Smith in 1925 when it was heading to the new power plant under construction below North Bend. At the new Lock No. 34, the tow lost barges when it grounded. At this point, the steamboat pilot realized the

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[185] "Bone, Evan- Interview and Memoir," 3-4, 8. The Oral History Collection of the University of Illinois at Springfield.
[186] Switzer, 347.
[187] Switzer, 343.
[188] Frank D. Holbrook, F. B. Duis, and William N. Dambach. "Water Power on the Ohio River." Professional Memoirs, Corps of Engineers, United States Army, and Engineer Department at Large Vol. 1, No 4 (October- December 1909), 422-445.

Army Corps of Engineers altered the original channel with the new lock. The pilot had only known this older, original channel and was quite surprised by the new one.[189] Before, steamboat pilots were the most knowledgeable of the river and its condition. However, the construction of locks and dams moved this expertise to engineers.

The lock and dam's designs would differ slightly in each locality. Generally, though, these locks and dams were strategically placed near the outlet of tributary streams to avoid the collection of silt and formation of bars as the streams empty into the Ohio and require approximately four years of consistent work by engineers.[190] Due to their placement, they had a role in not only changing the channels, and therefore ecology, of the Ohio River's mainstem but its tributaries as well.

Ecology of the Modern River

While the developments greatly assisted commerce, the Corps decelerated the water's velocity and transformed the river into a series of slack-water pools during periods of low water, which tended to localize pollution near its source.[191] The taming of nature through engineering led to a more predictable flow, but the alterations inadvertently influenced the river's natural dilution and flushing processes which previously carried pollution and filth down the river and were critical in an increasingly settled and industrialized Ohio Valley. Now wastes quickly accumulated in the river as it traveled from one city to the next, creating increasingly worse

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[189] Marjori Byrnside Burress. *Led By the River: The Story of My Father's Towboating Days*. Sen. John Heinz History Center, Detre Library & Archives (Pittsburgh, Pennsylvania).
[190] *Sundry Civil Bill, 1917: Hearings Before Subcommittee of House Committee on Appropriations, Part 1* (Washington: Government Printing Office, 1916), 445. Google Books; Chief of Engineers. *War Department Annual Reports, 1912,* 2 (Washington: Government Printing Office, 1912), 1278; "Bone, Evan- Interview and Memoir," 3. The Oral History Collection of the University of Illinois at Springfield.
[191] Edward Clearly, *The ORSANCO Story: Water Quality Management in the Ohio Valley under an Interstate Compact* (Baltimore: John Hopkins Press, 1967), 17.

environmental and human health problems for communities downstream. Often, this led to an unprecedented concentration of filth in the pools created by the dams, referred to as cesspools by public health officials as cesspools, especially in times of drought.[192] Communities along the Ohio River, suffering through the unanticipated outcomes of the transformation of the river, attempted to band together to find a permanent and agreeable solution to the mounting pollution issues. However, the proposed solutions, culminating in the creation of an interstate governing body known as the Ohio River Valley Sanitation Commission, did not challenge the unnatural structures installed by the corps that accentuated the pollution. Instead, it was widely accepted these structures were necessary and became permanent fixtures of the river. In 1929, when the Army Corps of engineers officially finished the project, the Corps estimated that annual maintenance of the Ohio River project was $2,000,000;[193] The U.S. government became encumbered by, and therefore permanently involved with, the Ohio Valley.

Permanence indicated commitment, not durability and longevity, however. The locks and dams required frequent repairs and "are no exception to the rule of constant minor breakages and deterioration."[194] Army Corp Engineer J.W. Arras stated in his 1911 report, “the greatest danger to the works would seem to lie in an assumption that the situation has been so fully mastered as to render failure impossible. So long as nature is known not to have exhausted her resources to produce new conditions or combinations eternal vigilance will probably furnish the surest

[192] In 1930, drought conditions resulted in stagnation of water behind the Army Corps of Engineers’ dams for at least a period of ten months. (“Minutes of Special Meeting of Health Commissioners Signatory to the Ohio River Interstate Stream Conservation Agreement,” Department of Health Central Files 1936-1965 (Water Resources), Series 1434 Box 53526, The Ohio History Society, Columbus, Ohio; Clearly, 23.
[193] Switzer, 348.
[194] Arras, 545.

safeguard."[195] The engineers understood that the river could not be fully understood at any given time; the environment and hydrological knowledge were always evolving. Therefore, "eternal vigilance" would be necessary after these changes to the Ohio.

Another impact of the new river was a lost sense of the river below its surface. Previously, especially during periods of low water, steamboat pilots needed to be aware of the river continually. However, engineering simplified the river in many ways. Captain Ellis C. Mace who grew up on and ran the river from 1875 to 1926, wrote in his memoir after discussing the difficulty of navigating the Ohio River during a period of low water in October 1900, "The modern steel steamers and fleets run many places somewhat straighter and glide on smoothly unmindful of what lies beneath. The mirror-like waters of the pools do not resemble much of the ragged shores and bars of yesterday."[196]

Local fishermen noted the changes in fish rather quickly. The river lost its riffle habitat, and the locks and dams prevented the natural movement of fish to spawn. These changes meant that the pool behind the dams would become popular areas to fish, changing the fishing culture, but migrating fish populations dwindled.[197] Darters struggled with the loss of riffle habitat. These fish depended upon the shallow, turbulent water that runs over rocks rather than the deep, predictable channel the Ohio River became with the slack-water project.[198] Even mussels, mostly

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[195] Arras, 551.
[196] Captain Ellis C. Mace. *River Steamboats and Steamboat Men* (Cynthiana, Kentucky: The Hobson Book Press, 1944), 260.
[197] Lou Smith, "Sport Sparks," *The Cincinnati Enquirer*, October 31, 1935; Barton Warren Evermann, "Description of a New Species of Shad (Alosa Ohiensis) with Notes on Other Food-Fishes of the Ohio River," *Part XXVII: Report of the Commissioner for The Year Ending June 30, 1901,* (Washington: Government Printing Office, 1902), 275. Indiana State Library (Indianapolis, Indiana).
[198] "Gilt-Darter- *Percina evides*." ODNR Division of Wildlife. Wildlife.ohiodnr.gov/species-and-habitats

those belonging to the Unionoidae family of freshwater mussels, felt this impact as their host fish were unable to travel the length of the river.

By 1932, Ohio jack-salmon runs were being affected as well, though fishermen saw this as a strange occurrence rather than a consequence of recent changes in the river.[199]Fishermen blamed the acid drainage from the old abandoned coal mines and big steel mills along the Upper Ohio River and sewage from municipal sources for the decrease in fish health, but they did not consider alterations to fish spawning habits.[200] While these are indeed dangers to fish, the change in fishing conditions was also due to the locks and dams as they stressed fish. Since this period, nevertheless, scientists have discovered the populations of darters, paddlefish, sturgeon, sauger, and walleye in the Ohio River dropped substantially in the twentieth century. Dams reduced the biodiversity in the Ohio River, and scientists in the following century aimed to correct the decline of these populations.[201]

The Ohio River Renaissance

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[199] Dave Roberts, "With Rod and Gun," *The Cincinnati Enquirer*, September 14, 1932.
[200] "Ohio River Fish," *The Akron Beacon Journal*, July 4, 1938; "Ohio River Fish and Cast-Netting, *The Courier Journal* (Louisville, KY), September 6, 1938; "Ohio river Fish Be Study Topic: Drouth, Water Pollution Is Blamed For Their Death," *Messenger-Inquirer* (Owensboro, KY), January 29, 1931.
[201] Nate R. Tessler, Johan F. Gottgens, Marc R. Kibbey. "The First Observations of the Eastern Sand Darter, *Ammocrypta pellucida* (Agassiz) in the Ohio Portion of the Maumee River Stem in Sixty-Five Years," *The American Midland Naturalist* 167 (January 2012): 198- 204; Jonathan A. Freedman, Benjamin D. Lorson, Richard B. Taylor, Robert F. Carline, Jay R. Stauffer, Jr., "River of the dammed: longitudinal changes in fish assemblages in response to dams," *Hydrobiologia* 272 (April 2014), 19-33. Jonathan Adam Freedman, "Dams, Dredging and Darters: Effects of Anthropogenic Disturbances on Benthic Fish Ecology," (Ph.D. diss., The Pennsylvania State University, 2010); Chris O' Bara, "The Ohio River: A River in Transition," *West Virginia Department of Natural Resources*. Wvdnr.gov; David Argent, William G. Kimmel, Rich Lorson, and Mike Clancy, "An Evaluation of Interstate Efforts to Re-Introduce Paddlefish to the Upper Ohio River Basin," *Northeastern Naturalist* 23 (2016), 454-465; "Sauger fishing starting to peak along the Ohio River," *The Herald Dispatch* (Huntington, WV), February 23, 2009.

With the completion of the lock and dam system, the Ohio Valley Improvement Association organized a parade of boats along the course of the entire Ohio River, from Pittsburgh to Cairo to demonstrate the importance of river transportation. On a Friday afternoon, October 17, 1929, the "Ohio River Celebration" was kicked off by a parade of steamboats traveling down the Ohio River about six miles from Pittsburgh to the Emsworth dam to mark the completion of the entire canalization project and allow the Ohio Valley cities to celebrate the accomplishment. Schools closed down for the afternoon. The guests in attendance were quite numerous and represented the federal government, industry, and local interests. For this celebration, Pittsburgh hosted five members of President Hoover's cabinet, governors, senators, six railroad presidents, and corporate executives to celebrate "the completion of the nine-foot stage in the Ohio River."[202] International guests were also invited, such as Egyptian minister Mahmoud Samy Pasha, "engineer of the famous Nile River waterways project." The steamboats went on a tour down the Ohio, stopping at several cities and towns in route and stopped in Cincinnati for the Ohio Valley Improvement Association's celebration on Saturday, October 18, where President Hoover gave a speech. From there, Hoover and the pageant traveled on to Cairo.[203]

At 10:30 am on October 22, Hoover dedicated the Ohio River Monument at Eden Park, which overlooks the Ohio River in Cincinnati, giving the first of two speeches. In his Ohio River

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[202] Noted vital guests in attendance include: Charles Adams (Secretary of the Navy), James W. Good (Secretary of War), Andrew W. Mellon (Secretary of Treasury), James J. Davis (Secretary of Labor), Robert Patterson Lamont (Secretary of Commerce), John S. Fisher (Governor, Pennsylvania), William G. Conley (Governor, West Virginia), Daniel Willard (Baltimore & Ohio railroad), General W. W. Atterbury (Pennsylvania), P. E. Crowley (New York Central lines), Charles J. Markham (Illinois Central), J. J. Burnet (Chesapeake & Ohio), Frank Taplin (Taplin railroad interests).

[203] *Light's Golden Jubilee; Ohio River Celebration*, 8-11. Heinz History Center (Pittsburgh, PA); Burress, 96.

Celebration speeches in Cincinnati and Cairo, President Hoover thanked the visionaries and engineers, referring to the latter as "patient men of my own profession," for the completion of the project. Hoover recognized the beauty in the pre-altered and old "romantic steamboatin' days" of the river, but he ensured the audience that "What the river has lost in romance, it has gained in tonnage."[204] Officials continued to use tonnage as be the measure by which to determine the progress and success of the project. Traffic on the river had more than doubled in the previous twelve years, a fact he mentioned in the speech. While acknowledging the "great accomplishment," Hoover also emphasized the permanency of the Ohio River project and the continuing need for intervention in the environment to maintain it. He pushed for continued "improvement" of what he saw as a "single great transportation system" that included the Mississippi River and the Great Lakes; the Ohio River lost its local and unique character in favor of a uniform system.

Postcards and memoirs of Valley residents from the twentieth century show the high interest in the locks and dams.[205] The U.S. Army Corps planned the grounds around the construction strategically so that they might become "showplaces along the Ohio."[206] Often, the locks and dams had park-like settings that encouraged people to rest. Marjori Burress noted, "From grassy slopes people could relax, watch the towboats and marvel at the workings of the

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[204] *Public Papers of the Presidents of the United States Herbert Hoover Containing the Public Messages, Speeches, and Statements of the President March 4 to December 31, 1929.* (Washington: United States Government Printing Office, 1974), 344, 358-259. Hoover.archives.gov.
[205] John Jackle and Dannell McCollum, *The Ohio: The Historic River in Vintage Postcard Art, 1900-1960* (Kent, Ohio: Kent State University Press, 2017).
[206] Burress, 96.

locks."[207] The interactions with the riverfront, therefore, were controlled and the landscape had a progressive narrative written into its presentation.

The praises of the project emphasized the "national benefit" of the Ohio River. By the 1920s, though, this benefit went beyond the movement of agricultural and industrial products to the include natural resource extraction. As a pamphlet on the Ohio River Celebration pointed out, "on or near the river banks are enormous deposits of mineral wealth, such as coal, fire clay, and limestone. The availability of these and other basic materials of the iron and steel, pottery, glass, and kindred manufactures supplied the foundation upon which has been erected the most highly developed industrial district in the United States, if not in the entire world."[208] While the new Ohio was created with coal in mind, by the late 1920s, other industries entered the scene; steel and oil increasingly used the river to save money on transportation costs.

[207] Burress, 96.
[208] *Light's Golden Jubilee; Ohio River Celebration*, 24-25. Heinz History Center (Pittsburgh, PA).

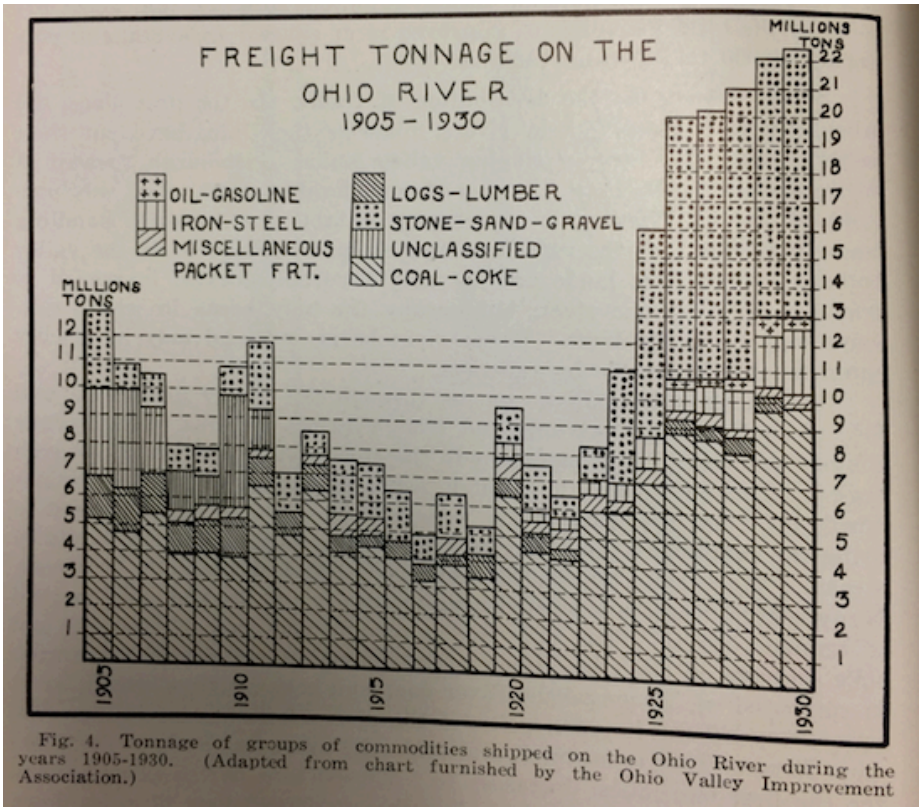

Fig. 4. Tonnage of groups of commodities shipped on the Ohio River during the years 1905-1930. (Adapted from chart furnished by the Ohio Valley Improvement Association.)

This chart was composed and included in the "Completed Ohio River Project" (1931) by J. E. Switzer. It demonstrates how drastically the Ohio River commerce shifted during the latter years of the Ohio River slack-water, or canalization, project.

As engineers and the federal government increasingly integrated the Ohio River into a national and global economic system, the environmental impact of the Ohio River canalization project is far beyond that of changing the river itself. The river became an aid to changing the Ohio Valley's air and land as well through the encouraging extraction of natural resources to the consumption of these resources such as coal. The Ohio River had long been "highly important as a line of communication between the East and the ever increasingly important West," but the new slack-water system increased the national, and therefore global, the economic value of the river.[209]

[209] Switzer, 340.

The increase in traffic itself is telling in the more extensive reach of the Ohio River with the completion of locks and dams. "Considering the Ohio River and its navigable tributaries, the gross traffic has shown an increase from a little more than 27,000,000 tons in 1917 to 56,000,000 tons in 1927, an increase of more than 100 percent."[210] While the canalization project may not be able to take all of the credit for this increase, given the significant growth in U.S. industry after the Great War, increased traffic encouraged the conception of a new Ohio River.[211] The particular location of the river, however, is essential to consider. With the increase in markets and demand, the Ohio Valley industrialized even more and bituminous coal, the lowest quality of coal with high sulfur, increasingly found its way to markets. The Ohio River also allowed for the shipment of other bulky goods, such as large pieces of metal, aggregate such as gravel, and oil. For this reason, the river could still compete with faster rail transportation simply due to the difficulty of transporting bulky goods. The Ohio River, therefore, became integral to many commodity chains that affected not just water quality but also air quality.

Between the 1870s and 1929, the businessmen of the Ohio Valley lobbied for the federal government to provide the enterprise and funding to transform Ohio River into a series of pools through the implementation of locks and dams that created a reliable, permanent depth of nine feet. The federal government's goal of this investment and ecological transformation, from the beginning, was aimed to benefit major national industries located in the Midwest, such as coal, that specialized in resource extraction. In the growing regulatory state, Americans did not view this as an overreach of the government but rather its responsibility. It did not stop with just one or two construction projects. With each successful lock and dam, it was easier to justify further

[210] *Light's Golden Jubilee; Ohio River Celebration*, 25. Heinz History Center (Pittsburgh, PA).
[211] *Light's Golden Jubilee; Ohio River Celebration* 25. Heinz History Center (Pittsburgh, PA).

improvement of the river that would have lasting impacts on the riparian environment. Piece by piece, the Ohio River, from its flow to its ecology, became the responsibility of the federal government.

Chapter Three:

Utilizing the Worthless Animal: The Musseling Industry of the Ohio River

"Shells, to most of us, merely are shells-

a creation of nature that it was thought could never be destroyed."[212]

In 1847, a fortunate man in Notch Brook, New Jersey, discovered a valuable pearl in a freshwater mussel. News of this discovery and the pearl's $2,500 price tag spread throughout the country, generating frenzy. Fishermen sent approximately $15,000 worth of pearls to New York markets, but the Civil War stifled these endeavors. This industry did not subside forever, however. In 1868, fishermen again discovered many fine pearls in Ohio's Little Miami River, a tributary to the Ohio, and again just eight years later in a stream in Waynesville, Ohio. Excitement grew, and a "pearl mania" swept the nation. By the 1880s, a pearl fever grasped the American Midwest with the "same spirit of the gold seeker of 1849." Thousands of visitors, many with no familiarity or attachment to the Ohio Valley environment that housed mussel beds, flocked to creeks and rivers to gather mussels in pursuit of pearls. The fever waned in some areas as mussel beds became exhausted and localities were "cleaned out," but it would simply pick up again in new bodies of water. In the decades to come, the result was a "wholesale destruction" of mussels.[213] By the 1920s, the impact of the mussels' disappearance had become quite apparent to scientists and fishermen alike.

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[212] "'Clammers' Banished from Twelve Indiana Mussel-Fishing Areas, the Object Being to Save Pearl Buttons from Total Extinction." *The Indianapolis News* (Indianapolis, IN), March 17, 1928.

[213] One newspaper explained the long delay in exploitation of mussels in the following way: "Americans themselves paid little attention to the mussel beds no doubt partly because they had so many more valuable resources to exploit."; Frederic J. Haskin, "The Menaced Mussel," *Portsmouth Daily Times* (Portsmouth, OH), February 14, 1921. "New Industry: Mussel Shells

Along the Ohio-Mississippi system and its tributaries, fishermen rediscovered freshwater pearls in mussels known as unionids, the most common family of native mollusks in the Ohio River. While the Ohio contained 127 species of mussels, the family of unionids were the most iconic and heavily sought after. Therefore, their decline over a period of about fifty years is easy to trace compared to that of other species. Freshwater musseling was not new to the Ohio Valley, though; Native Americans fished for unionids long before European arrival and settlement. However, nineteenth-century Euro-American settlers viewed these round, black or brown, heavy shelled mollusks as a valueless waste animal as they were too tough for human consumption. Thus, mussels were able to reproduce relatively undisturbed for over a century after the arrival of Euro-Americans. For many settlers, perhaps the mussels' only redeeming characteristics were the insides of their shells, which sported superb colors of white, pink or blue, and their potential for making pearls. In terms of riparian ecology, though, mussels were far from a waste and their extensive removal in the late nineteenth and early twentieth centuries had a lasting impact in the Ohio Valley.[214]

Cities and their manufacturing grew out of the Ohio River's natural resources and powerful flow. The freshwater pearl seekers and pearl button industries increasingly extracted the necessary natural filter animals from the riparian environment over the decades. Mussels draw in water through their siphons and as the water passes over their gills, they feed on

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Gathered Along the River Find Ready Sale," *The Cincinnati Enquirer* (Cincinnati, Ohio), June 20, 1903. "About Pearls and Pearl Fishing," *Democrat and Chronicle* (Rochester, New York), September 9, 1903; "Fishers for Pearls Find World Famous Gems," *St. Louis Post-Dispatch* (St. Louis, Missouri), March 3 1901.

[214] George Frederick Kunz and Charles Hugh Stevenson, *The Book of the Pearl: The History, Art, Science and Industry of the Queen of Gems*, (New York, New York The Century Co, 1908). "Farmhands Searching for Ohio River Pearls." *The Indianapolis News* (Indianapolis, IN), October 10, 1903; "Pearls in the United States," *Poughkeepsie Eagle-News* (Poughkeepsie, New York), December 11, 1889.

microscopic plants, animals called plankton, and bacteria. Therefore, large mussel beds have the ability to significantly alter water clarity and quality. Humans, nevertheless, continued to believe they could manipulate and control the fauna of the Ohio River and the river itself to their will without consequence. During this critical period, deepening and channelization physically and ecologically altered the river, putting the animals' survival at risk. Industry accelerated the destruction of the critical mussel population and consequently further sped the deterioration of the river's health. Nevertheless, most people did not recognize the connection until the 1930s, when accumulated knowledge to save a previously thriving pearl and button industry contributed to conservation efforts.

The mussels' story, therefore, provides insight on how conservation ideology took form in the Ohio Valley outside the framework of beautification efforts. The musseling industry illuminates the connection between urban business interests and those of early conservationists. The business and environmental concerns worked together. As industry grew to depend on the mussels, the knowledge developed to ensure longevity of the industry encouraged river conservation efforts, as legal and policy historians Brian Balogh and Hedrick Hartog have shown in the studies of other extractive industries. However, there is also a more practical end to this in that it was simply in the direct interest of business to funnel investments towards conservation. Therefore, as Richard Andrews points out in his work, it was in the best interest of the U.S. government to do so. However, parties were unconcerned with preserving the thriving Ohio River in its entirety, but rather continued production of one of its native animals, the unionids.[215]

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[215] Brian Balogh, "Scientific Forestry and the Roots of the Modern American State," in *The Associational State*, (Philadelphia: University of Pennsylvania Press, 2015); Hedrik Hartog, "Pigs & Positivism," *Wisconsin Law Review* (1985); Richard N. L. Andrews, *Managing the Environment- Managing Ourselves: A History of American Environmental Policy* (New Haven, CT: Yale University Press, 1999).

This may strike us today as a questionable approach, considering ecology predicates that everything in a habitat is connected. Nevertheless, it did not occur to early twentieth century conservationists that an individual species could not thrive without also preserving its ideal environment. Therefore, prioritizing the river highway and industry led to hyper-focusing on multiplying a single animal, the mussel, within the river, rather than the river as a biological entity. The priority became the animal, without the ecological recognition that this required a healthy river and a balance between propagation and extraction.

Thus, the musseling industry encourages us to think historically about the Ohio River beyond the creation of the "water highway" of the nineteenth and twentieth centuries. The Ohio River is an ecological entity and humans disrupted its system as a consequence of industrial and commercial goals. This is a lasting impact that industry, government and residents realized in a matter of just a few decades. In this way, the musseling industry became a warning of intended and unforeseeable consequences of both the commons and river engineering. The tragedy of the commons is a theory that proposes that individuals, who share a resource and are unchecked by regulation, will act according to their own benefit and thus deplete the shared resource.[216] In the nineteenth century, lawmakers' beliefs in common regulation resulted from this idea that law needed to protect public, or "common," lands and resources.[217] River engineering damaged the mussels' habitats but the other lesson was that unchecked fishing in the river led to quick depletion of the resource.

While manufacturers and cities increased the pollution and sewage load and engineers altered the river's flow, industrialists also removed the river's primary filters. The pollution load

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[216] Garrett Hardin, "The Tragedy of the Commons," *Science* Vol. 162, December 13, 1968.
[217] William Novak, "Common Regulation: Legal Origins of State Power in America," *Hastings Law* Journal Vol. 45, 1994: 1082-1083.

intensified during this period, and humans would attempt to address the health issue and beautify the river with technological innovation. Technology did not effectively replace the natural filters, and the pollution continued to take its toll on the remaining mussel populations. Habitat loss, pollution and intentional large-scale removal of mussels by pearl seekers and button manufacturers generated a perfect storm with rippling effects. Without mussels, the river that nineteenth century Ohio Valley residents knew would disappear.

This story adds to our understandings of the Ohio River's rapid transformation around the turn of the twentieth century. Scholars and scientists tend to target industrial pollution and the re-engineering of the river as explanations for rapid change. However, evidence suggestions that the removal of unionids played a key role. To answer how and why the Ohio River changed, the fundamental system of filtration must be considered alongside the altered water flow and seasonal fluctuations.[218]

Accumulating Knowledge on the Unionids

While this narrative concentrates on the Ohio River, the late nineteenth century musseling industry was not unique to the valley; freshwater pearls were found from Wisconsin to Georgia, and button factories lined the Mississippi River. Nevertheless, it is a vital piece of the Ohio's story. It illustrates not merely how industrialists, specifically button manufacturers, viewed and utilized the river but one of the environmental strains placed on the riparian environment. Out of the musseling industry's concerns for a healthy and prosperous river, a new

[218] Excellent pieces of scholarship on Midwest fisheries are the following: John O. Anfinson, *The River We Have Wrought: A History of the Upper Mississippi (*Minneapolis: University of Minnesota Press, 2003); Margaret Bogue, *Fishing the Great Lakes: An Environmental History, 1783*-1933 (Madison: University of Wisconsin Press, 2000); Phil Scarpino, *Great River: An Environmental History of the Upper Mississippi, 1890-1950* (Columbia: University of Missouri Press, 1986).

understanding of how the river's habitat functions as an entity arose. Musseling encouraged scientific investigation into the riparian environment as a whole, even if it was initially focused on a single animal.

When commerce and industry took interest in the freshwater mussels, very little was known about the animal as a biological entity. Their numbers and varieties, life cycle and ecological niches were up for debate within scientific circles. Most late nineteenth-century knowledge of Ohio River mollusks stemmed from the work of a French American botanist and natural historian by the name of C.S. Rafinesque, who taught at Transylvania College. He conducted field research during a long surveying trip during the 1830s and 1840s and was one of the first to study and describe the numerous unionids of the Ohio. He found that the river was remarkably rich in number and variety of mollusks. This research resulted in several publications, and it was through his work that the Ohio River mollusk *Campeloma crassula* was recognized as a distinct *Unio*. This recognition was critical, as previously American naturalists lumped all 1,500 genera members into just four genera.[219] However, Rafinesque's work concerned itself with discovering, describing, cataloging and naming the animals, an endeavor generally only of interest to scientists.

Musseling was attached to the natural rhythms of the river. The season began just as the ice thawed but was often well underway by the spring, often the middle of April, and ran until the first day of December. In the early years, individuals, families, and small groups of seasonal farmers who lived and worked the land along the river extracted mussels from the river with basic tools like hooks. Many Ohio Valley residents valued this seemingly individualistic

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[219] Thomas Say is another important naturalist who conducted this work; Leonard Warren, *Constantine Samuel Rafinesque: A Voice in the American Wilderness* (Lexington: University of Kentucky Press, 2004), 164-165.

pioneerdom; a newspaper referred to these men as "survivals of the old individualistic America in which even a poor man could be his own boss and taking his living from a bountiful nature which nobody owned." Early hunters who searched for pearls did so on foot and wore rubber suits, consisting of boots and long pants. Often, these men would wear a bucket and a strap holding up a "water telescope" around their necks. Bystanders could watch these hunters walk around, slouched down over the viewer of their water telescopes and long poles equipped with spring clasps in hand.[220]

Small-scale fisherman invented many specialized methods and equipment for pearl hunting. Pearl hunters with the capital utilized clumsy-looking customized johnboats equipped with poles and four-prong hooks. When these men reached their preferred location above a mussel bed, they tossed out long pipes, often four at a time, to which the long hooks were attached. These hooks then dragged the bottoms for anywhere from three boat lengths to an eighth of a mile until they came into contact with open shells. When the hooks contacted the mussels' flesh, the mollusks responded defensively by immediately closing their shells, unintentionally hooking themselves. Then, the fishermen brought the hooks to the surface, removing often forty to seventy animals in a single sweep. From there, the fishermen would disembody the mussel, remove valuable pearls, and, once the button infrastructure was in place,

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[220] While the season runs through December, the months of July and August were known for poor musseling periods, and September and October were among the best fishing months; For more information on Ohio River fishermen, including mussel fishermen, please see: Jens Lund, "Fishing as a Folk Occupation in the Lower Ohio Valley," (PhD diss., Indiana University, 1983); "Town Boats of Shell Pavement: Leavenworth, Ind., Has Streets of Pearl," *The Arkansas Gazette* (Little Rock, Arkansas), November 13, 1904; "The Mussel Is At Its Best," *Pittsburgh Daily Post* (Pittsburgh, PA), April 23, 1905; "One of the Unique Industries Carried on Along the Ohio River," *The Indianapolis Journal* (Indianapolis, IN), April 17, 1904; Frederic J. Haskin, "The Menaced Mussel," *Portsmouth Daily Times* (Portsmouth, OH), February 14, 1921; "Pearls: How to Find and How to Value Them," *The Tennessean* (Nashville, TN), September 1, 1901; "About Pearls and Pearl Fishing," *Democrat and Chronicle* (Rochester, NY), Sept 9 1903.

gather the shells to sell to button factories.[221] As time went on, businessmen began to take over the industry and it became further mechanized.

Industrialists sought to increase their odds of finding pearls through the improvement of technology. The first technological innovations occurred with the basic johnboats used for musseling. The mussel-brail, or crow-foot dredge, was invented in 1897 near Muscatine, Iowa, a location that was also a hotbed for musseling during this period. This was essentially a larger version of the hook-equipped johnboats, but being larger, these boats could gather more mussels at a time. These dredges could also be used in the deeper portions of the river, allowing for the extraction of even more mussels. With more capital wrapped up in their equipment, mussel fishermen had to collect more mussels to profit from this investment.

This method of randomly collecting and searching through mussels was unsatisfactory for some who sought more control over the process and ultimate product's output and quality. In 1879, Charles L Moore established a mussel farm along the Ohio River, only about forty miles south of Cincinnati, to breed and utilize the "utterly valueless" and inedible freshwater mussels. According to a newspaper reporter's interview with Moore, the mussel farmer researched the works of Linnaeus from a century prior. Linnaeus observed fresh-water mussels would cover any foreign substance embedded in their shells with nacre, over time developing a beautiful pearl. While natural parasites would customarily serve as this foreign substance in the river, this process could take place with the assistance of humans by purposefully placing objects, often a grain of sand or shell fragment, inside mollusks. Moore, however, preferred to insert wax into mussels, which he believed was gentler on the mollusks' tissues. By 1891, Moore saw the fruits

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[221] Sanford Smith Interview, Illinois Digital Oral Archives; The Topeka Daily Capital, 22 July 1900; Jens Lund, *Flatheads and Spooneys: Fishing as a Folk Occupation in the Lower Ohio Valley* (Lexington: University of Kentucky Press, 1995), 263

of his efforts; "I [Moore] was satisfied that I could grow just as good pearls as Mother Nature, and now I am egotistical enough to think that I am a rather better workman in this line than that ancient and reliable dame."[222] Moore believed he could manipulate and improve nature through the river's animals. This "improvement" of the river would assume other forms, however, as husbandry required a significant time commitment and organization.

One of the pearl hunters' greatest challenges was learning how to open the mussel's shell without harming a potential pearl. This process took a while to learn, and many fishermen ruined pearls in the learning process as they experimented with boiling the entire animal or other harmful approaches. Ultimately, pearl hunters arrived at two main methods to open shells: steaming and cutting. One man who worked on the riverboats in his youth, Sanford Smith, noted that shell hunters around Madison, Indiana, used steamers and "every fellow had a cooker of his own." When cutting a mussel open, pearl hunter pried open shell with a heavy Barlow or "old table knife." The hunter inserted the knife between the two halves of the shell and cut the two ligaments that bound the two sides of the animal's shell. As soon as those ligaments were cut, the shell would open. At that point, the pearl hunters examined the flesh of the mussel thoroughly and press the flesh to feel for any hard substances: pearls.[223]

American pearl hunters tended to be wasteful and destructive in their endeavors compared to other freshwater pearl industries, such as those in China. Fishermen in the U.S. typically destroyed the entire animal to access the pearl. In other places, fishermen would use pinchers to gently pry open a mussel's shell and then remove a pearl or introduce a particle that would encourage the development of a pearl before returning it to water. In America, fishermen

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[222] "Gotham Gossip," *The Times-Picayune* (New Orleans, Louisiana), August 30, 1891.
[223] Sanford Smith Interview, Illinois Digital Oral Archives; "Pearls: How to Find and How to Value Them," *The Tennessean* (Nashville, TN), September 1 190.

viewed the animal as a waste; it was the most efficient to remove unproductive mussels and find the ones that had produced a pearl. While explaining the modern, "odd" version of pearl hunting that took hold in the United States, an article from 1901 noted the following: "If [the mussel] has no pearl in him, the mussel is thrown out, and if he has a pearl for his captor, the pearl is removed and he is thrown out, anyhow." Another reported, "After the flesh is examined as directed, the shell is thrown aside and a new one cut open in the same manner. This is continued with patience, remembering that while every ten to fifty mussels contains some sort of worthless pearl, that only about one in every thousand contains a salable pearl." A fisherman could open as many as 1,500 mussels a day, creating a considerable amount of waste. Steamboat passengers traveling the Ohio could recognize they were approaching a mussel camp through the "horrible, stomach-turning stench... of the putrefying flesh of the discarded mussel 'innards.'" Nevertheless, this "open and toss" approach was seen as the most efficient method as it merely took one pearl to earn anywhere from $5 to $600.[224]

Industrializing Musseling and the Pearl Button

Once industrialists with capital entered the musseling business in the late nineteenth century with large dredges and hired crews, most fishermen had no connections to these unfamiliar environments. Therefore, they had little personal incentive to maintain a certain population of mussels in a particular locality. Sanford Smith, a freight business owner who spent 32 years on the Ohio River hauling freight and passengers between Louisville, Kentucky, and Madison, Indiana, recounted the following story in his late life interview:

[224] Harlan Hubbard, *Shantyboat: A River Way of Life* (Lexington: The University Press of Kentucky, 1977), 12; "Odd Pearl Fishing," *The Inter Ocean* (Chicago, IL), March 25, 1901; "Peals: How to Find and How to Value Them," *The* Tennessean (Nashville, TN), Sept 1 1901; "Ohio River," *The Weekly Register* (Point Pleasant, WV) July 19 1899.

> There was a fellow by the name of McFarland, he came around from St. Louis and brought a boat and barges around here. He had a crew of maybe twenty-five or thirty men working for him. The river was really low at that time and up there at Hanover was a big bar on the Kentucky side. It would come out dry two-thirds of the way across the river, that throwed the channel on the Indiana side and all the water had to run through that channel. So the trend of the current was very light and right through that channel, he musseled in there, there was a big mussel bed in there, he musseled in there one whole summer. Took out barges loads and took them around to St. Louis. They took out barge loads of mussels right out of that chute….

Smith's story shows that musselers travelled all along the river system and collected as many animals as they could in a very short time frame. In this case, McFarland and his crew spent an entire summer obtaining mussels from a limited portion of the Ohio River, in which the flow channeled and concentrated mollusks. *The Courier Journal* noted in 1911 the results of such a method of musseling: "business [near Utica] is not as prosperous as last year on account of the locality having been closely dragged for two or three seasons."[225] Dredging, an expensive method of musseling, quickly depleted valuable mussel beds.

With the substantial waste involved in pearl hunting and mounds of opened mussels along the riverbed, a new industry emerged. In the mid-nineteenth century, fishermen reserved part of the mussel to feed to hogs or utilize as bait for catfish, but they threw the shells aside; there had to be a better use for these beautiful, hard shells. Around 1890, a German button maker by the name of John Boeple determined that the mussel shells of the Ohio-Mississippi River system were indeed suitable for buttons and believed they could compete in the world market. Boeple proceeded to set up his own small button factory along the Ohio River in Cannelton, Indiana.[226] Although there is little proof he made a significant profit from this pioneering business, he would eventually move his factory to Muscatine, Iowa. This was an important

[225] "Pearl Hunters," *The Courier-Journal* (Louisville, KY), June 24, 1911.
[226] "The Story of the Pearl Button Industry," *Quad-City Times* (Davenport, Iowa), April 9, 1911.

moment in the foundation of a new American industry. Up to this point of time, button factories in the United States obtained raw and manufactured materials, often shells and porcelain, from the China Sea. This was expensive and precarious. Therefore, considerable interest arose in the local raw material. Pearl button factories swiftly popped up along the river to be near some of the largest freshwater mussel camps at the time, such as those in Bethlehem and Utica, Indiana. The pearl button industry took hold in the Ohio Valley.[227]

The Ohio River was a leading supplier of mussel shells in the 1880s and 1890s, and, thus, attracted many button factories by the early 1900s. In 1891, a large pearl button factory opened along the Mississippi River in Muscatine, Iowa, and served as a model for those to come in St. Mary's, West Virginia; the Ohio cities of Cincinnati and Manchester; the Indiana cities of Lawrenceburg, Leavenworth and Madison; and many other locations from Pittsburgh to Cairo, Illinois. By 1903, "button factories [began] to dot the river banks all along the Ohio… and forces of workmen [were] kept busy about nine months a year dragging the river bed for 'raw material." The largest of these Ohio River factories were located in Madison and Evansville, Indiana. The shells for button making were, in part, leftovers from the practices of contemporary pearl hunters. However, they were also found in "great abundance in the gravel beds and sand bars along the river" from the previous two decades' pearl seekers. Men could easily gather enough shells to earn $1.50 to $2.00 a day, significantly increasing the return on musseling labor. These

[227] Frederic J. Haskin, "The Menaced Mussel," *Portsmouth Daily Times* (Portsmouth, OH), February 14, 1921; "Government in Button Industry," *The Daily Gate City* (Keokuk, Iowa), January 27, 1915; Frederic J. Haskin, "The Menaced Mussel," *Portsmouth Daily Times* (Portsmouth, OH), February 14, 1921.

factories benefitted greatly from the pearl hunting mania and eventually took over as the principal industry exploiting mussels along the Ohio River.[228]

The new button industry created a preference for a certain species of mussels within the Unionidae family. In the Ohio River, fishermen could acquire a number of mussels with the common names of "yellow sand shell," "black sand shell," "deerhorn" and "buckhorn." The predominant species of interest to button manufacturers was the *Quadrula ebena*, which took on a common name derived from racist associations of the shell's color. This animal was relatively small, only about 3 inches in diameter, and preferred muddy sand and gravel river bottoms. It was known for its thick and heavy shell, black or dark outside skin and white epidermis, which was the ideal base for buttons. The "butterfly," a small sized and fine reddish-brown mussel was the also desirable in the button industry and, of all U.S. rivers, it was most abundant in the Ohio.[229] Clearly not all mussels were valued equally. As most musseling involved mass collecting mechanically, many mussels were discarded without any use. This also encouraged further expansive collecting, as fishermen might catch thousands of mussels but discard them if they weren't the prime species.

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[228] "Removing Mussel Shells Said to be Unsanitary," *The Courier Journal* (Louisville, KY), July 29 1903; "Driftwood," *The Courier-Journal* (Louisville, KY), August 8, 1903; "About Pearls and Pearl Fishing: Growth of the Fresh Water Fisheries," *Democrat and Chronicle* (Rochester, NY), Sept 9, 1903; "Mussel Shell Buttons," Cincinnati Museum Blog Post, June 7 2017, http://www.cincymuseum.org/blog/mussel-shell-buttons; Hubbard, 162; "Town Boasts of Shell Pavement: Leavenworth, Ind., Has Streets of Pearl," *The Arkansas Gazette* (Little Rock, Arkansas), November 13, 1904; "New Industry: Mussel Shells Gathered Along the River Find Ready Sale," *The Cincinnati Enquirer* (Cincinnati, OH), June 20, 1903.

[229] Hugh M Smith, "The Mussel Fishery and Pearl-Button Industry of the Mississippi River," *U.S. Fish Commssion Bulletin 1898*, 289- 314; "Sewage in the Mississippi is Destroying Pearl Button Mussels," *St. Louis Post-Dispatch* (St. Louis, Missouri), December 3, 1899; "Farmhands Searching for Ohio River Peals," *The Indianapolis News* (Indianapolis, IN), October 10, 1903

Saving an Industry

In the late 1890s, the U.S. Fish Commission recognized the "wanton wastefulness" of musseling and began taking steps toward protecting pearl fisheries along the Ohio River affected by the "pearl mania." Local newspapers, such as *The Louisville Courier-Journal*, attempted to deflect blame from contemporary choices and attributed the decline in mussels to mound builders. Nevertheless, the commission knew better and became outspoken in their stance against the mass collection of mussels. It proposed "to work up such a sentiment against the wholesale destruction of our mussel shells, as now going on, that each State will pass laws prohibiting it." Despite the issue plaguing many states, the U.S. Fish Commission lacked the authority to create such law itself; it was up to the individual states to regulate pearl hunters and their practices. The Commission's goal was not, however, to preserve the animals for their role in the ecological system. Rather, it sought to prevent "pearl fevers" that threatened and may even bust the economic viability of the industry.

Until 1898, the U.S. Fish Commission focused on the musseling industry of the east coast. However, the industry had grown enough in the Midwest that the commission finally devoted much of its 1898 bulletin to discussing the pearl button industry. One article by Charles T. Simpson of the department of mollusks of the United States National Museum, focused much less on the industry as so many others had done up to this point and more so on the "biological standpoint" of the "pearly mussels." Following a deep report on the mussels' life cycles and the contemporary problems they faced with the pearl industry, he invited the question, "Can anything be done to save these mussels?" Simpson concluded that, only twenty years into the pearl rush, this would be problematic. Not only were the pearl hunters, who seemed insistent on "exterminating" the freshwater mussels, reducing the populations, but other environmental

conditions made it difficult for mussels to survive. "It is not likely that pearl hunters or button-makers will ever completely exterminate any of the species," Simpson wrote. "But sewage and much of the refuse from manufacturers will kill everything downstream." He saw the mussel problem as beyond that of simply controlling fishermen through laws and the difficulty of enforcing those laws. "Cities and mill-owners" were equally to blame and even more difficult to control. Simpson was correct: mussels experienced many threats beyond pearl-seekers and button factories.[230]

Between refuse and pollution from cities and factories, and the river engineering projects by the U.S. Army Corps of Engineers, the Ohio Valley had its work set out to effectively address the complex myriad of problems connected to musseling. As filter animals, mussels hold prime position in the Ohio River's ecology. Lying on the river bottom, they open their shells slightly. The animals' tentacles catch and retain plankton and other microscopic creatures that would otherwise throw off the ecological balance in the waters. Pollution that entered waterways during this time had a significant impact on mussels by killing their food source and poisoning them with increased bacteria and chemicals. It contributed to water quality issues to such an extent that urban pools of water often experienced noticeable loss of diversity and volume in their mussel populations, even well before the construction of impoundments behind dams. "Pollution of the water by refuse from cities and manufacturing establishments," one article claimed, "is the most serious menace to the mussel beds next to the operations of the fishermen."[231] However, visions

[230] Chares Simpson, "The Pearly Fresh-Water Mussels of the United States, their habits, enemies and diseases," *U.S. Fish Commission Bulletin 1898*, 279-288.
[231]Watters and Myers Flaute; "Sewage in the Mississippi is Destroying Pearl Button Mussels," *St. Louis Post- Dispatch* (St. Louis, Missouri), December 3, 1899.

for the river as a primary transportation and industrial network created problems for the river even well beyond this pollution; the mussels would lose their habitat during this period.

The river's re-engineering around the turn of the century impacted mussels greatly. As they absorb nutrients by filtering water, maintaining high water quality is very important for the survival of mussels. Too much silt deposition, either mud or sand, or biological and chemical pollution could kill the animals. It was not uncommon for fishermen in the early twentieth century to discover entire mussel beds wiped out from heavy deposits. Humans placed blame for mussel eradication on natural forces the majority of the time, though. For example, in 1900, a newspaper investigating the effects of pollution placed the blame for the "extensive destruction of mussels" on flooding, as this moved sand and mud. Sandbars, which frequently shift, were also blamed and seen as "natural forces" out of the control of humans.[232] While these natural fluctuations did lead to the demise of small populations, these were relatively isolated incidents that did not impact the entire length of the river. Pollution, continuously deepening the river, and artificially developing a new slack-water system that concentrated filth and restricted the movement of the fish affected the entire river system.

The scientists did not consider whether the role of human's alterations to the river caused the mussels' disappearance in the early twentieth century; there is little evidence of investigation into whether the newer, man-made structures of locks and dams harmed mussel beds. However, today the relationship between the common river-altering efforts, such as the creation of locks and dams, and declining mussel populations is well understood. Native mussels depended on a free-flowing river, but the constructed large dams and channelization by the Army Corps of Engineers transformed the moving water into stagnant waters and increased the river's depth.

[232] "Pearl Buttons," *The Topeka Daily Capital* (Topeka, Kansas), July 22 1900.

Between the 1878 and 1929, the corresponding period with the pearl mania, the Corps built an additional fifty-one more locks and dams to ensure a nine-foot river depth and "canalized" the length of the river. Dams not only move silt, eventually favoring silt- tolerant species of mussels such as the *Leptodea* and *Potamilus*, but also restricted the range of mussels and their fish hosts. The dams concentrated acid pollution and the animals in the same areas. Mussels struggled to filter the river, but the acidic water also significantly reduced their health and therefore populations.[233] These structures changed the river's ecology by transforming its flow but also through further endangering the mussels.[234]

This tended to localize pollution near its source. The filter feeders, including mussels, were sensitive to this pollution, especially when it included ammonia or heavy metals such as that from coal mines and iron and steel factories. In addition, the changed flow suspended the sediments that would typically continue down river which dropped to the riverbed, where the mussels had borrowed themselves. This extra, contaminated sedimentation buried the mussel beds.[235]

Dams equally threatened the symbiotic relationship with fish, as they act as barriers to movement. Mussels are crucially dependent on the health of fish, because their life cycle

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[233] "Pollution Has Killed River Mussels Here," *Pittsburgh Daily Post* (Pittsburgh, PA), November 24, 1907.
[234] William Eckman Kreisle, "Development of the Ohio River for Navigation, 1825- 1925," Master's Thesis, University of Louisville, 68-76, 127-9; Captain Sobieski Jolly Papers (Jolly Papers), 1876-1898, Mss 1046, Cincinnati Museum Center, 3.; R. R. Jones, *The Ohio River: Charts, Drawings, and Description of Features Affecting Navigation, War Department Rules and Regulations for the River and Its Tributaries, Navigable Depths and Tables of Distances for Tributaries* (Washington: Government Printing Office, 1922), 150.
[235] Edward Clearly, *The ORSANCO Story: Water Quality Management in the Ohio Valley under an Interstate Compact* (Baltimore: John Hopkins Press, 1967), 17; "Sewage in the Mississippi is Destroying Pearl Button Mussels," *St. Louis Post- Dispatch* (St. Louis, Missouri), December 3, 1899.

depends on a symbiotic relationship with host fish. Fish need the river to be filtered properly to ensure their food source, reduce pathogens, and ensure access to adequate oxygen. The mussels also depend on fish, such as skip jack, black bass, crappies and catfish, to complete their reproductive cycle. Parent mussels sendoff young, microscopic mussels, called glochidia, who spend their first few weeks of life as parasites in the gills of fish, which essentially serve as their nurseries. It is critical for reproducing mussels that fish swim past them in order for their young to survive. However, pollution of the late nineteenth and early twentieth centuries killed fish at high rates by poisoning them and their food source. Therefore, pollution injured the mussels not only directly but in terms of their reproductive process. The lack of a healthy host fish meant a decline in mussels.[236]

With the economic potential, however, the Fish Commission found it difficult to stop the pearl fever. The Interior Pearl Fisheries of America, represented by its founder and pearl dealer Herman Myer who was hailed as the "Pearl King," toured the country to promote pearl fishing in 1899, just as the Fish Commission sought to pull back such entrepreneurship in the industry. Myer devoted a significant amount of time to the Ohio Valley, travelling from Portsmouth, Ohio, to Point Pleasant, West Virginia. He believed the valley had the most potential in the musseling industry. He purported that one in every 1,000 shells would bear a pearl, meaning men could easily earn $2 to $10 a day. However, stories of lucky men earning much more, over $600 in a matter of weeks or even in a single pearl, circulated around the Valley.[237]

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[236] "Life History," *U.S. Fish and Wildlife Services*, December 18, 2006, https://www.fws.gov/midwest/mussel/life_history.html; "Our Pearl Button Industry," *The Indianapolis Star* (Indianapolis, IN), July 21, 1920.
[237] Howard Washburn, *American Pearls* (Ann Arbor: Ann Arbor Press, 1908), 31; "Pearl-Bearing Waters to Be Protected Hereafter," *The Courier-Journal* (Louisville, KY), February 5 1899; "Ohio River: Rich in Pearls of Great Value," *The Weekly Register* (Point Pleasant, WV), July 19, 1899.

The words of the commission could only go so far to protect mussels and convince states to enact laws. The trajectory of the river along six states contributed to its vulnerable ecological position. Going back to 1792 law, Kentucky had jurisdiction over the Ohio River along the state's border to the low-water mark on the north riverbank. While the purpose of this law was to control trade, including the sale of enslaved people, the archaic law created obstacles for northern states. No one in West Virginia, Ohio, Indiana, or Illinois could fish for mussels in the river without first obtaining a license from the Kentucky Fish and Game Commission. In addition, this meant that no one could fully regulate the collection of river resources without the backing and approval of Kentucky. While states to the north of the river could enact laws for collection of mussels in the waters that lay solely within their state lines, the protection of mussels depended on a single state, Kentucky.[238]

Musslers became an easy target to explain the decline of mussels, though, and the government claimed industrialization of musseling played a large role in the decline of mussels. Well equipped, well organized musseling teams replaced the previous small scale, individual fishermen. These teams were a visible explanation. A newspaper reporter wrote in 1912,

> The mussel supply has been heavily drawn upon in the past few years… Mussel shells are in great demand for the manufacture of buttons, and the desultory pearl hunter has been succeeded by the organized fishing fleet which takes thousands of the mollusks where the pearl seamen took dozens. The mussel having become a commercial factor to such an extent that the supply is threatened with extinction.

The button manufacturers also increased efficiency by streamlining the process of purchasing the raw material; "button manufacturers throughout the United States [had] mussel fishermen

[238] "Drafts Bills to Save Mussels," *The Courier-Journal* (Louisville, KY), February 4, 1918.

stationed at various points along the river."[239] The industry increasingly became mechanized, further improving the dredges, and the extraction of mussels from the Ohio grew more efficient with each season.

By the 1910s, newspapers widely reported a significant depletion of mussels, demonstrating the decline was public knowledge. The question of regulating the catching of mussels in the Ohio River went before every legislature in the valley. In his 1912 memorial address to the General Assembly of Kentucky, a mussel catcher named William T. Barret warned, "the Ohio has been worked hard from one end to the other, and if the present system of working the beds continues, in two or three years, they will all be 'whipped out.'" Therefore, he suggested the state legislature regulate the number of boats per mile that could extract mussels from the Ohio beds and limit the amount each boat could catch to 15 tons a year. Barret anticipated this would protect mussel beds substantially and allow the animals to continue purifying the water while ensuring the continuation of the button industry. He went on to also propose that the government limit tools to hooks, outlawing dredges and tongs, and the season to when the river is no more than 20 feet deep.[240]

As public beaches along the river began to close due to sewage issues, and local health officials increasingly acknowledged the declining water purity, newspapers also began to spread knowledge concerning the role of mussels. In an article titled "Removing Mussel Shells Said to be Unsanitary," *The Courier-Journal* reported, "attention has been called to the alleged service

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[239]"The Mussel Supply," *The Courier-Journal (Louisville, KY)*, 30 April 1912; "Open Season Declared on Mussels By Kentucky Game and Fish Commission- All of Ohio River Now Unrestricted Territory," *The Cincinnati Enquirer* (Cincinnati, OH), April 11, 1934.
[240] William T. Barret, "The Mussel Shell Beds Need Protection," *The Nautilus* (XXVI), October 1912: 61-64; "Open Season Declared on Mussels by Kentucky Game and Fish Commission- All of Ohio River Now Unrestricted Territory," *The Cincinnati Enquirer* (Cincinnati, OH), April 11, 1934.

mussels perform in purifying river water that is used for drinking purposes… Mussels, it is said, are great scavengers, as serviceable as catfish, in removing from the river much of the refuse that is objectionable."[241] This understanding, though, did not translate into sufficient local support for the conservation of mussels.

While states debated how to address the growing problem, they also looked to the federal government for help. In 1907, the U.S. government acted within their lawful means to address the depleting mussel populations. The U.S. Bureau of Fisheries investigated the issue and sought to begin "the artificial propagation of the commercial mussel." Federal authorities in the Government Fisheries Bureau sought to secure the future of the pearl button industry by breeding mussels and creating artificial pearls in the Cumberland River, a tributary that enters the Ohio around Paducah, Kentucky. However, it realized that accumulating more knowledge about the native mussels themselves was the necessary first step to saving the animals. A report from the U.S. Committee on Merchant Marine and Fisheries mentioned that "many fundamental scientific facts" concerning the mussels' breeding season and early life still needed to be understood. In order to create this knowledge and begin breeding mussels to distribute across the country in hopes of providing raw material for the button industry, the government set up a research station in the Cumberland River, Tennessee.[242]

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[241] "Removing Mussel Shells Said to be Unsanitary," *The Courier-Journal* (Louisville, KY), July 29, 1903.

[242] "Pearl Mussel is Dying Out," *The Pittsburgh Press* (Pittsburgh, PA), July 12, 1907; "Plans for Grow Pearl Mussel: Government to Save Industry that is Nearly Destroyed," *The Pittsburgh Press* (Pittsburgh, PA), October 3, 1907; "Uncle Sam Starts Farming for Pearls," *The Sun* (New York NY), March 22,1914; "Mussels for the Button Industry," *The Rock Island Argus and Daily Union* (Rock Island, IL), May 15, 1914; "The Mussel Supply," *The Courier-Journal* (Louisville, KY), April 20, 1912; "Will Furnish Clams: Uncle Same to Stock River," *The Indianapolis Star* (Indianapolis, IN), February 27, 1908.

Because the federal government lacked the authority to act much beyond breeding high quality mussels to distribute, it was up to the independent states to protect rivers. In 1928, Indiana's legislature sought to achieve just that. It passed what newspapers called the "most sweeping yet important, restrictive measures ever." Indiana banned "clammers" and "musseling" in many of its rivers. In addition, the legislature sought to protect the mussel population by outlawing the taking of any animal with a shell under two inches wide. However, as Kentucky continued to hold jurisdiction over the Ohio River, Indiana could only regulate musseling in its tributaries, and the measures were largely ineffective to save Ohio River mussels.[243]

The declining supply of mussels created market value increases. A report from Jefferson, Indiana, in 1917 claimed, "The business of mussel gathering in the Ohio River is booming. Shells which were worth $12 a ton now are worth $25, and large shells, which formerly hardly sell for $4, now command $10." Pearl buttons also increased in price and consumers began to feel the mussel shortage. "The price of buttons is rising," reporter Frederic Haskin of the *Portsmouth Daily Times* wrote, "with the result that the remaining mussels are hunted with more diligence than ever.[244]

Ultimately, widespread concern for employment of individuals trumped the concern for mussels and their role in maintaining a clean river. In 1934, during the Great Depression, the U.S. Game and Fish Commission opened the entire course of Ohio River, from Pittsburgh to the Mississippi River, to mussel fishing for the first time in its history. This action went directly against the advice of the Commission's mussel expert, William M. Barrett, who "urged that the

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[243] "'Clammers' Banished from Twelve Indiana Mussel-Fishing Areas, the Object to Save Pearl Buttons from Total Extinction," *The Indianapolis News* (Indianapolis, IN), March 17, 1928.
[244] "Boom in Mussel Trade: Some Ohio River Fishermen Are Gathering Big Wages," *Fitchburg Sentinel* (Fitchburg, Massachusetts), February 27, 1917; Frederic J. Haskin, "The Menaced Mussel," *Portsmouth Daily Times* (Portsmouth, OH), February 14, 1921.

river be opened only from Louisville to Union County [Kentucky], recommending that all of the section north of Louisville remain closed during the spring and summer." When questioned about the issue, Commissioner Robert M. Hunter, declared that the goal was to "give employment to hundreds of men throughout the entire length of the river in Kentucky" and to carry "out the policies of President Roosevelt to give employment to the greatest number of people." [245]

Threats to mussels and the button industry went well beyond unregulated fishing, of course. The Ohio River was substantially altered in the beginning of the twentieth century through the installation of structures and increased pollution from human activities along the river. Sanford Smith, a lifelong Ohio Valley resident who worked on the river, blamed the decline of the industry on the new dam and lock structures in Bethlehem, Indiana: "When they put this dam in down at Louisville why it just settled mud all over the beds and you couldn't get to the mussels. They were there but they were covered up with mud, maybe four feet deep. No more mussels. No, that killed the mussel business."

In the early twentieth century, it became increasingly apparent that the federal government, not just the states, would have to act to ensure a healthy and thriving population of mussels. The federal government created sites to breed and release host fish that would carry the young mussels down river. However, the response and hyper-focused efforts on solely reproducing mussels in aquaponic farms were too late to save the button industry. Even if environmental pressures, from declining mussel populations to river flooding, had not ruined the pearl button industry's factories, the unreliability of the material collection and price increases led to material changes in button manufacturing. The increased use of synthetics such as plastics

collapsed the industry. Plastics became very popular during the 1920s and by the end of World War II, the last of the nation's independent button factories, the William E. Boyd Factory in Meredosia, Illinois, closed its doors.[246] With the temporary success of the commercial musseling industry, fishermen and industrialists would look for other potential commercial fish, such as Ohio River Shad, but these efforts did not produce return.[247] The Ohio River was to serve the growing commerce and industry, and its aquatic life was secondary to this purpose as it could not bring profit in itself.

The Ohio Valley utilized its freshwater mussels for profit and spawned an industry that successfully competed on the world stage. However, this came at a cost to a river already struggling to process the pollution load from urban centers. In 1900, approximately twenty years into the Ohio River's pearl mania, scientists and fishermen considered the Ohio River to be the richest river in terms of diversity and sheer population of mussels; it was home to 127 of the 297 native North American mussel species. The mussels settling in groups, or "beds," and their role of filtering the river contributed to their vulnerability in a capitalistic society, but humans made choices that played on that vulnerability. Between prioritizing jobs and profits, the pearl hunters and the button industry, and the Army Corps of Engineers' projects, humans significantly reduced the mussel population, altering the river's ecology. As of 2018, out of those 127 species, eleven native species are extinct and forty-six others are endangered or classified as species of concern. The river lost most of its unionids. The changes favored more resistant mussel species,

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[246] For example, the 1937 flood destroyed the button factory in Leavenworth, Indiana; Stephen Taylor, "Indiana's Pearl and Button Boom," Hoosier State Chronicles: Indiana's Digital Newspaper Program.

[247] Barton Warren Evermann, "Description of a New Species of Shad (Alosa Ohiensis) with Notes on Other Food-Fishes of the Ohio River," *Part XXVII: Report of the Commissioner for The Year Ending June 30, 1901,* (Washington: Government Printing Office, 1902), 275. Indiana State Library (Indianapolis, Indiana).

formerly less abundant in the river, which eventually allowed for invasive species such as zebra mussels to thrive. Biologists to this day struggle to bring back the few Ohio River's native mussel species that are still populating the river. The increased utilization of one type of animal, the mussel, in the Ohio River for just a few decades producing enduring effects on its ecology. Nevertheless, interest in addressing the Ohio River's environmental decline did increase in the years following the musseling industry. While the mussel conservation efforts were largely ineffective, the Ohio River's transformation during the turn of the century would aid support for new river clean-up efforts, such as the creation of the Ohio River Valley Sanitation Commission.[248]

[248] Richard Nevers, "Partnerships for Ohio River Mussels." *U.S Fish & Wildlife Services: Endangered Species*, September 21, 2016, https://www.fws.gov/midwest/endangered/clams/ohio_rvr.html; G. Thomas Watters and Carol J. Myers Flaute, "Dams, Zebras and Settlements: The Historical Loss of Freshwater Mussels in the Mainstem," *American Malacology Bulletin* 58, no. 2 (2010): 1- 12; Rick Steelhammer, "Mussel, once feared extinct, brought back to Ohio River," *The Seattle Times*, October 7 2017.

Chapter Four

From Expected Tragedy to Prevention Plans:
Responses to Floods in the Ohio Valley, 1880s-1930s

In March 1913, as flood waters began consuming homes, farms, and entire towns, communication proved to be inadequate. Rumors spread around the towns in the Ohio Valley. The Great Miami River, a tributary of the Ohio River that is typically only a couple of hundred feet across, grew to 3 miles wide. Residents believed a levee above the Ohio town of Hamilton broke and Dayton would meet the same fate. In addition, newspapers incorrectly reported that south of the town, in Cincinnati, a 200-passenger train had been taken by flood waters. It was challenging to know the full extent of flooding, but these tragedies did not seem out of the realm of possibility given that flooding long existed in the historical memory of cities and towns in the valley. Generations long passed down stories of floods completely wiping towns off of the landscape. Most residents did not have personal experiences with significant flooding, but previous floods left marks in collective local narratives. At times, the few residents old enough to remember floods of 1866 and 1898 did themselves a disservice by seeking out areas that escaped previous environmental disasters.[249] They failed to understand how the landscape changed and

[249] Geoff Williams, *Washed Away: How the Great Flood of 1913, America's Most Widespread Natural Disaster, Terrorized a Nation and Change It Forever* (New York: Pegasus Books, 2013), 226; Disaster historiography is a fairly broad and expansive set of literature, covering topics such as war, political upheaval, humanitarian persecution, and os much more. Here, though, I will use disaster in reference to solely environmental disasters. Disaster historiography emphasizes the unpredictability of human decisions and, often, how humans' efforts to control nature lead to disaster in themselves. Such disasters also fundamentally change communities and nations forever in terms of politics, built environment and so much more. Williams' monograph on the 1913 flood, one of the few recent histories that discusses flooding in the Ohio Valley, is an example where flooding at the center of a historical narrative. In this narrative, Ohio Valley residents demanded a federal government response to protecting citizens to prevent another great flooding disaster. Other monographs where flooding disasters take center stage in the early twentieth century include the following: John Barry's *Rising Tide: The Great Mississippi Flood of 1927 and How it Changed America* (New York Simon and Schuster, 1997); *Paris Under*

the unpredictability of flood paths. The flood events between the 1880s and early twentieth century were devastating in terms of human cost and economic loss amounting to millions of dollars from damaged property. The focus on commerce's needs, in terms of high water and easy river access, impeded the long-discussed flood control structures. After the 1913 Ohio Valley flood, the federal government financed flood control structures in some localities, but these programs did not address valley-wide planning until the aftermath of the thousand-year flood of 1937.

Perceptions of flooding changed over a period of about five decades, and residents' interest in mitigating their risk grew across the valley in the early twentieth century. The Ohio Valley's growing faith in engineering, fueled by the completion of navigation projects, encouraged this change in perception of permanent flood control structures. In addition, the national nature of the twentieth century flooding, as opposed to the more isolated previous floods, brought wide-spread attention to the issue during a period of federal government

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Water: *How the City of Light Survived the Great Flood of 1910* (New York: St. Martin's Griffin, 2010) by Jeffrey A. Jackson; Kenna Lang Archer's *Unruly Waters: A Social and Environmental History of the Brazos River* (University of New Mexico Press, 2015); and *The Thousand Year Flood: The Ohio- Mississippi Disaster of 1937* (Chicago: University of Chicago Press, 2011) by David Welky.

Outside of disaster historiography, flooding typically appears as smaller portions of historical narratives of rivers. It plays a significant role in the following: Marc Cioc's *The Rhine: An Eco-Biography, 1815-2000* (Seattle: University of Washington Press, 2002); Deborah Pickman Clifford and Nicholas R. Clifford's *"The Trouble Roar of the Waters:"Vermont in Flood and Recovery, 1927- 1931* (Durham: University of New Hampshire Press, 2007); David Blackbourn's *The Conquest of Nature: Water, Landscape, and the Making of Modern Germany* (New York: W. W. Norton & Company, 2006); *Transforming New Orleans and Its Environs: Centuries of Change* (Pittsburgh: University of Pittsburgh Press, 2000) edited by Craig Colten; and Amahia Mallea's *A River in the City of Fountains: An Environmental History of Kansas City and the Missouri River* (Lawrence, KS: University Press of Kansas, 2018).

Another important thread of this field concerns how the state reacts to, and at times grows, out of disaster moments: Michele Landis Dauber, *The Sympathetic State: Disaster Relief and the Origins of the American Welfare State* (Chicago: University of Chicago Press, 2012).

expansion. The region diversified its economy well and river transportation lost its dominance on visions for the river as railroads became more prevalent in the shipping industry. With commercial demands on the river having waned, this shift allowed residents of urban centers to demand changes to the river designed to protect residents and their property from the river's tendency to flood, even where those changes might impede commercial traffic. This opened up the possibility for flood control structures, such as levees, and flood prevention structures, such as reservoirs.

The Ohio River flooding is a story about slowly changing perceptions from living with the risks of close proximity to a large river in the nineteenth century toward a willingness to invest in permanent intervention to prevent flooding damages in the mid-twentieth century. This movement was not perfectly linear, however. Tensions, between the regional shipping and manufacturing interests such as those of the coal industry and tow boats, the local residents and municipalities, and the federal government which sought to appropriately invest in infrastructure that served the nation as a whole, grew with each flooding event.

An ecological narrative that accounts for the human experience and technological changes of the Ohio River would not be complete without an analysis of its historical flooding events. Natural disasters, including floods, grab the interest of historians as they are memorable, often unpredictable events that leave their marks on society. They also provide an opportunity to see how societies function under stress, when divisions such as class become more apparent and communities re-evaluate their priorities.[250] In the Ohio Valley, river rises were commonplace in

[250] This can be observed in environmental historiographies of disaster; Greg Bankoff, Uwe Lübken, Jordan Sand, and Stephen J. Pyne, eds, *Flammable Cities: Urban Conflagration and the Making of the Modern World* (Madison, WI: University of Wisconsin Press, 2012); Richard S. Newman, *Love Canal: A Toxic History from Colonial Times to the Present* (Oxford: Oxford University Press, 2016); Charles E. Rosenberg, *The Cholera Years: The United States in 1832,*

the late winter and early spring months. Rainfall and snow melt could quickly raise the river level, regularly leading to flooding. Commercial shipping interests considered this "spring rise" a useful change in the river, however, as the greater water depth allowed boats to navigate easily. Therefore, the local residents' fears of high waters and desire to control flooding gained strength as engineers guaranteed the river depth of nine feet and humans came to a expect a more controlled, rational river.

As the floods became more destructive in economic terms, residents began to ask the reasonable question of whether floods had "worsened" in terms of water height and intensity and, if so, whether humans were to blame. Engineers and scientists in the late nineteenth century and early twentieth century found themselves in a revolving debate regarding the changing intensity of flooding. This question, perhaps, is not the most useful inquiry of a historian. Whether or not floods were actually worsening matters less than the prevailing perception that flooding was out of control. An analysis of whether flooding played a role in how humans came to understand their environment, its risks, and perceived ability to control nature provides insight into the changing perception of the river itself.

Severe floods determined which towns survived during the settlement of the west.[251] However, severe flooding did not affect all parts of the Ohio Valley equally, and while rises were an important part of the cyclical nature of the river, great floods were not an annual occurrence. For instance, in 1907, flood waters provided the highest water level recorded up to that point in Pittsburgh and a water stage of 62.1 in Cincinnati, but the river barely rose above flood stage in

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1849, and 1866 (Chicago: University of Chicago Press, 1987); Natasha Zaretsky, *Radiation Nation: Three Mile Island* (New York: Columbia University Press, 2018).

[251] David Stradling, *Cincinnati: From River City to Highway Metropolis* (Charleston, SC: Arcadia Publishing, 2003).

Cairo.[252] Therefore, the impact of flooding was relative dependent on geographic location, despite the fact that entire system was susceptible to flooding.

The Ohio River's location is ideal for severe flooding. Fueled by moisture from the Gulf of Mexico in the south that gets picked up by passing weather systems, the valley is susceptible to significant rainstorms simply due to its relative location. Common atmospheric conditions also lead to the build-up of snow and ice, as well as frequent rain. Therefore, scientific experts blamed excessive precipitation and snow melts for most of the flooding in the Ohio Valley until at least 1913, when two engineers, A. H. Horton and H. J. Jackson, attributed flooding to five leading causes: excessive rainfall, the rapid melting of accumulated snow, the failure of reservoirs, the forming and breaking of ice jams, and the breaking of levees.[253] These engineers recognized the intertwined nature of natural and human causes of flooding. Ohio River flooding served as a reminder of how the greater ecosystem influences the river, and science's limitations in predicting the behavior of the river. In the early twentieth century, engineers became implicated in matters of high water, as communities looked towards the profession for answers and permanent solutions.

Even as normal behavior, frequent flooding became an important factor in the ecology around the Ohio River. The flood plains possess fertile soils, making them attractive agricultural land. However, floods are known for intensifying the river's tendency for erosion and bank instability, contributing to arguments for growing flood control infrastructure.[254] This nutrient exchange made riverbanks popular locations to settle and establish towns. However, the towns of

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[252] A. H. Horton and H. J. Jackson, "The Ohio Valley Flood of March-April, 1913." *Department of the Interior United States Geological Survey*. Water Supply Paper 334, 13.
[253] A. H. Horton and H. J. Jackson.
[254] D.J. Hagerty, M.F. Spoor, C. R. Ullrich, "Bank failure and erosion on the Ohio River," *Engineering Geology* 17 (3), October 1981, 141-158.

the Ohio River Valley grew substantially in the nineteenth century. Environmental historian Uwe Lübken points out that new patterns of vulnerability had been created by the changes in flood plain utilization over the late nineteenth and early twentieth centuries. Conscious efforts to build up close to the river placed specific communities, particularly minority communities, at risk.[255]

1880s series of floods

The evolution in responses to flooding in the Ohio Valley can be observed in the changes between flooding episodes over a period less than 60 years: the series of floods in the 1880s, the 1907 and 1913 floods, and the 1937 flood. After each flood, engineers, municipalities and organizations such as the Red Cross attempted to fully record the events in excruciating detail, often day by day, and to place the recent event in the context of the long history of the Ohio River flooding. At the beginning of the twentieth century, once the Army Corps of Engineers began completing its navigational projects, the Corps' and businesses' focus began to shift when major floods halted trade and destroyed cities' infrastructure. In Pittsburgh, for instance, the 1907 flood brought about an organized flood control movement that only grew with the subsequent flooding.[256]

Accounts of floods were more than accounts of historical memory, remembering the suffering of people and the responses of churches, government and the community at large. Authors included a substantial amount of detail to aid scientific attempts to explain and rationalize the flooding trends, with the hope that engineers could control the waters. Most flood accounts focus on the human and property loss, but the details of these accounts in diaries,

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[255] Uwe Lübken, "Rivers and Risk in the City: The Urban Floodplain as a Contested Space." *Urban Rivers: Remaking Rivers, Cities, and Space in Europe and North America*,
[256] Roland M. Smith, "The Politics of Pittsburgh Flood Control, 1908- 1936." *Pennsylvania History: A Journal of Mid-Atlantic Studies* 42, January 1975, 8.

letters, books, and newspapers also provide an insight into how people understood their environment and fears of that environment. Through flooding, people also became more aware of "nature." Cities carefully watched the water level, and every inch rise was noted, demonstrating the increase in anxiety. For example, typically unseen animals were brought out of hiding through the flood waters; people often noted how the remarkable number of snakes, for instance, they saw in the water. Flooding created the natural elements that quickly led to a natural disaster, but human interventions up through the 1930s created a perfect storm for human-made disasters.

Flood damage can result from simple inundation or the effects of the current. The wall of water can instantly damage buildings and infrastructure, but the currents pick up structures that collect and then crash into infrastructure. In addition, the "yellow, slimy, fine, penetrating mud that is deposited everywhere" damaged housing and places of business.[257] In buildings that periodically flood, such as those along the banks, the damage is accumulated and contributes to rapid depreciation that cannot be traced to a single event.

In the early years of the Corps' projects, the floods of the 1880s and early decades of the twentieth century had a significant impact on the way Ohio Valley residents viewed the role of the river. Previously, residents and business owners viewed freshets as a positive force as it allowed to the easy transport of productions from the eastern states such as coal and for connection of Ohio Valley products to markets in the west and south. The Ohio River rise meant that business would thrive. However, the rise and drop in water levels were too unpredictable for a world that, with the addition of railroads, came to expect uniformity and predictability.

[257] "The City Planning Commission." The Official City of Cincinnati, Ohio. *The City Planning Commission* (Cincinnati, OH), 1925, 149.

Engineers had long discussed altering the Ohio River and took action to re-engineer the river to be as reliable as the iron horses. However, investment in reliability of water levels did not necessarily imply investment in protection from more extreme river rises during the nineteenth century.

Small levees were a part of this plan, as a flood control measure and as a measure to cease the "caving of the banks."[258] Around 1834, levee building began in southern portions of the Mississippi River just north of the Red River. However, resistance to levees because of fears from an increase in the height of flood waters to failed engineering prevented more significant efforts to control floods. Following floods in 1832 and 1840, the residents of Cairo pursued building an embankment and levee around the city to protect. However, the city would have problems in the 1849 flood, as the Ohio levee overflowed in several different places. The city continued to improve levees over the next couple decades with smaller floods before the floods of the 1880s once again inundated the city.[259]

After a decade of relatively little flooding, the Ohio River flooded three consecutive years from 1882 to 1884.[260] Each year, the water levels increased, with 1884 being the worst; Cincinnati's water level reached 71 feet, and only the flood waters in 1937 would exceed this record. While the high-water levels were the greatest in recent memory, the impact of these disasters was more about timing than the height of the water itself. People had come to accept modern amenities, and the growth of recent decades led to growth in areas closer to the river. Also, settlement in the valley grew substantially and often abutted the riverbanks. Much of the

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[258] "River Problems." *The Times-Democrat* (New Orleans, Louisiana), April 14, 1884.
[259] John McMurray Lansden, *A History of the City of Cairo, Illinois* (Chicago: R.R. Donnelley & Sons Company, 1910), 73-78.
[260] A. H. Horton and H. J. Jackson, 15.

newspaper coverage each year focused on human suffering. The illustrated New York newspaper, *Harper's Weekly* even covered the stories. Its illustrations showed flooded streets and families on roofs of houses that appeared as islands in the flood waters, and its narratives focused on this story of human tragedy and triumph.[261] The river was an antagonist that humans were never quite sure about when it would attack.

In 1883, the Ohio Valley experienced "the greatest flood since the settlement of the country."[262] In April of 1883, Clarence Egbert, Secretary Director of the Geological Survey, wrote:

"Water Street, Cincinnati," *Harper's Weekly*, Cincinnati Public Library

> The flood affected every resident of the city [Lawrenceburg, Ind.]. The ponderous engineers could no longer serve to pump water into either reservoir. The gas works were so far submerged that primitive methods of producing artificial light were forced upon the community, and the public lamps on the street corners were dark… The lantern, long disused, was brought from the cellar and the attic by its fortunate owner, while those not so fortunate felt, rather than saw, their way from place to place.

[261] "Water Street, Cincinnati-Photographed by Landy." *Harper's Weekly*. March 11, 1882. Folder: Ohio River Little Miami, Floods, Weather Events, and Scenes. Cincinnati & Hamilton County Public Library- Cincinnati Room.
[262] "The Flood of 1883," Kentucky Department of Libraries and Archives (Frankfort, KY).

Already well adjusted to the use of gas lighting, the absence of artificial light disturbed residents' everyday routines. Worse than the absence of artificial light, however, was the loss of potable water from waterworks. "Thus," reported Egbert, "was the city partially deprived of a further supply of three necessaries of life- water, light, and fuel."[263] In the industrial cities, such as Ironton, residents understandably found it "repulsive" to even consider drinking the filthy, yellow flood water.[264]

In 1883, the Ohio Valley "sustained heavy losses, from loss of stock, houses, fences, etc." when the Ohio River left its banks.[265] These losses went beyond farms and houses, however. On the Licking River, a tributary of the Ohio in Northern Kentucky, a boat lost 1,700 barrels of whiskey to the flood waters.

Although work was already underway by the 1882 flood, the floods gave Colonel Merrill, Corps of Engineers, the popular support he needed to go forth on the river engineering projects. The locks and dams underway were designed to ensure a navigable water level, and it did not appear outside of the realm of possibility that ensuring a water height would lead to additional improvements to protect communities against flooding. Merrill was undoubtedly a leader in these efforts to make a reliable Ohio River. The river improvement continued through the 1880s, despite the water rising considerably and a "failure of Congress to provide the necessary appropriations."[266] Many of the damages from the flood, such as the portion of the Louisville and Portland Canal that washed away, were corrected rather quickly. The Falls of the Ohio's work benefitted from a period of low water following the 1883 flood; the engineers successfully built a

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[263] "The Flood of 1883," 25.
[264] John L. Vance, "Great Flood of 1884 in the Ohio Valley," 67. Cincinnati Room, Cincinnati Public Library.
[265] "The Flood of 1883."
[266] "The Flood of 1883," 8-9.

moveable dam. However, the snag-boat "E.A. Woodruff" and two dredges, "Ohio" and "Oswego," did not have the funds to operate for at least an entire season. Even the navigation landscape improved, as the Light-house Board on the Ohio River, led by Naval Commander R. S. McCook, continued to add beacon lights.[267]

There was a consensus among engineers and the federal government that the river needed to be improved for navigation rather than residential purposes. Flooding appeared to be just a normal part of living near a river, without any reasonable technological solution. "No river of the same magnitude fluctuates in depth so much as the Ohio," claimed geologist Clarence Egbert. "Twice or oftener during most years the river rises to 45 feet 6 inches, when the occupants are compelled to vacate the premises at the foot of Commercial Row, and the event is scarcely remarked. Extreme low water is 23 inches, and high water 66 feet 4 inches, the difference being 64 feet 5 inches."[268]

As the land became an "immense inland sea," the power of levees paled in comparison to the force of flood waters. In Cairo a reporter wrote the following:

> Standing on the Ohio levee and gazing in the direction of the Kentucky shore the sight is thrilling… The spectacle is Nature's own. Since creation's dawn the waves have towered in the same majesty and roared in the anger of their mightliness. Confronted on land by floods which have burst their barrier, the spectacle becomes impressive and appalling. The force exerted is immeasurable, the possible destruction limitless, human resistance a mockery.[269]

Knowing the dangers involved in allowing the Ohio to rise and burst the upper levee, Shawneetown even cut into its lower levee and allowed the water to flood the town.[270]

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[267] "The Flood of 1883," 9.
[268] "Letter to Clarence Egbert, Private Secretary Director of the Geological Survey April 13 1883," 23. Kentucky Department of Libraries and Archives (Frankfort, KY).
[269] "The Floods." *Chicago Tribune* (Chicago, Illinois), February 20, 1883.
[270] "The Floods." *Chicago Tribune* (Chicago, Illinois), February 20, 1883.

Another flood occurred in February and March 1884 in which the flood waters reached a height unprecedented in recorded history. The flood of 1884 earned the title of "The Great Flood" in many accounts. January was an unusually cold month, and ice "gorges" formed in the Ohio River system. During the first week of February, though, the river began to thaw. On the second of February, upstream in the Allegheny and Monongahela Rivers, which feed into what becomes to Ohio in Pittsburgh, rivermen began to report a significant drop in the water levels; within 24 hours, the Monongahela fell almost five feet. The Ohio River began to rise along the cities of Ironton, Cincinnati, Evansville, Louisville, and Cairo. By the end of February 3rd, Cincinnati's water levels reached just over forty-nine feet. Historical records indicate that the growing flood waters drew significant interest, but many in Cincinnati did not expect the river to reach or exceed the flood height of the previous two years. Surely, they thought, the flood of 1883 would not be repeated. Steamers delivering freight, however, did not transport the shipments onto the Cincinnati public landing, for fear that the waters would reach the product before morning.[271]

"The History of the Great Flood of 1884," written shortly after the event, did not simplify the damages of the flood. It painstakingly recorded the damages river town by river town. As the river's waves and swells began to splash over the curbstones at the corner of Second Street and the Public Landing, the greater Cincinnati area quickly prepared their homes and businesses to be revisited by the river again for the third time in three years. The homes and businesses of the Millcreek began to prepare "for the worst;" the Stock Yards began to move thousands of head of cattle. Newport, Kentucky, saw over one hundred families vacate their homes in a single day. In Lawrenceburg, Indiana, a city which was half wiped out by the 1883

[271] Vance, 2-4, 30.

flood, was noted to be awaiting with fear. All watched the levees with great care. "The hurry and panic of all this was like the evacuation of an army before the advent of superior forces," noted the account. "It baffles all attempt at description."[272] Flood waters had already hit Allegheny and Pittsburgh particularly hard and destroyed approximately 30,000 residents' homes.[273]

The *Wheeling Intelligencer* reported damage in the city, from the suspension of travel to the failing telegraph and telephone wires. The agricultural industry and residential housing areas were hit:

> Fields were swept bare of the soil, fences were carried toward the gulf, outhouses and barns demolished or swept far away, and houses were overturned or floated from their sites, many of them crushed to pieces, and others stranded miles from their former locations. Household goods of all kinds were irretrievably ruined, to say nothing of the damage sustained by mills, factories and stores. All told, the loss in the immediate vicinity of Wheeling…. was placed early in the progress of the flood at $6,000,000.[274]

In further evidence of the how Ohio Valley residents experienced nineteenth century flooding, a sad scene took hold in "the oldest one of the prettiest and most flourishing towns on the Ohio River"- Marietta, Ohio. The town lost several bridges: the Marietta and Harmar bridge, Blannerhasset's Island railroad bridge, the county bridge, a draw-span bridge, and Lowell bridge. In the little town of Cochransville, Monroe County, Ohio. only two of forty-one house were left standing after the flood.[275]

The human experience of the flood was traumatizing, and the records indicate that some did not fare as well as others. In some towns, unaware of how much and how quickly the river would rise, families had to move several times to get to the point of safety. For others, such as

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[272] Vance, 6-8.
[273] Vance, 12.
[274] Vance, 14.
[275] Vance, 18-19.

around Marietta where most of the buildings, including churches, filled with water, "the steamboats became asylums for fugitives, generally and humanely opening their cabins to all."[276] As with the 1883 flood, the lack of communication with those outside of a town was bothersome, as mail and telegraph connection ceased, and the most significant losses "fell upon those least able to bear them."[277] For many Ohio Valley residents, the flood experience was that of constant movement and re-evaluation of the risk. J.R. Wiatt, from Guyandotte, wrote:

> The oldest inhabitant [of the town] moved his perishable property above the marks of '32 and '47 (which latter at this place is just one foot above the mark of '83), and rested content, saying it was impossible that the water could reach him there. But his predictions had not the slightest tendency to keep the sullen swelling of the river, which continued to rise.[278]

Others moved to courthouses, churches and other public buildings.

Much of the damage, a "frightful picture," would not be realized until the flooding resided. Many towns reported debris all over their farmlands. Churches, stores, mills, home and factories were all among the losses. An observer from a relief boat noted the "melancholy" scene he observed post-flood:

> "The fertile fields are the bottom of the river… All the fences adjacent to the river have disappeared. Logs, lumber, coal-flats and barges have drifted out into the cornfields and meadows."[279]

In the town of Middleport, 99 out of 100 houses were said to be lost. "Many people floated off in their houses along the river," James Beall, a flood survivor from Proctorsville, wrote to his mother.[280]

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[276] Vance, 20.
[277] Vance, 22.
[278] Vance, 56.
[279] Vance, 26,41.
[280] Vance, 54.

The situation was disastrous for livestock. While many farmers took cattle, horses, and mules to higher ground, they often quickly tied them up to fences or trees. As the water rose beyond expected levels the animals, their owners were unable to return to the animals and move them resulting in many animals being found drowned or starving with their leads still attached to gnawed fences and trees. Other animals found their way into buildings and "were found dead on staircases and in halls and parlors."[281]

With so much lost, such as in the town of Middleport, residents often became desperate and, as they were pressed for food sources while surrounded by flood waters, the drowned cows and hogs in the rushing waters were "caught in the mighty flood, and towed to shore and cut up and eaten."[282] The suffering of the wildlife was quite apparent too; flood survivors also noted "strange and novel incidences… such as rabbits, cats, rats and all sorts of varmints of the small kind being found in tree tops."[283] Several accounts also noted the number of snakes seen during the flood, as they have been chased out of their holes in the ground.

The disaster scene from the flood waters were difficult for humans to process. The *Ironton Register* pointed out that the worst part of the 1884 flood was that the city had just gone through a calamity the previous year. The reporter wrote, "We thought we had, a year ago, an experience so terrible that, in the nature of things, came but a time or two in a century, but now the calamity returns in proportions that are perfectly appalling."[284] If nothing else, the floods reminded Ohio Valley residents that nature was still in control. The Ironton *Register* included, "One could see everywhere, how weak were all human calculations compared to the awfulness

[281] Vance, 44.
[282] Vance, 44.
[283] Vance, 45.
[284] Vance, 64.

of the flood."[285] Even as humans were trying to control it through engineering, the floods reminded them that their calculations could only be so correct.

For many, it seemed as though the issue of increased flooding was due to an ongoing pursuit for profit. U.S. Engineer Col. Wm. E. Merrill claimed, "It is not the axe of the woodman that is to be feared, but the plow of the farmer…. even the great flood of 1884 was equaled by floods that occurred before the white man's axe had felled a single tree in the Ohio Valley."[286] He was not the only one who felt this way; a *New York Times* article noted, "Unquestionably, the great [flood] disasters of recent years are the result of the condition of the earth's surface as modified by human action."[287] Here, in the aftermath of the 1880s flooding, we see a period of self-reflection that is very much in line with the rise of conservationist thought in the late nineteenth century.[288]

For some scientists, the heavy rain seemed to be an over-simplified explanation for the occurrence of the Great Flood of 1884, as it did not explain why the Ohio Valley experienced significant floods for three consecutive years. Scientists began numerous studies to understand and disseminate the knowledge regarding why the "three of the greatest overflows in the history of the river… occurred in the [previous] three years, at the same season."[289] One explanation by Col. Merrill of the Army Corps of Engineers emphasized the substantial deforestation that

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[285] Vance, 64.
[286] "The Ohio River Floods," *American Contract Journal,* March 22, 1884, p. 137. Google Books; "The Difficulty of Preventing the Ohio Floods," *Science*, Vol. 3 March 28, 1884. JSTOR.
[287] Uwe Lübken, "Rivers and Risk in the City: The Urban Floodplain as a Contested Space." *Urban Rivers: Remaking Rivers, Cities, and Space in Europe and North America*, 138.
[288] "The owners of timber lands, however, will continue selling timber, and clearing off the ground for the purpose of raising thereon more profitable crops, and the owners of cultivated lands reclaimed from the forest, will hardly allow them to return to their original condition." ("River Problems." *The Times-Democrat* (New Orleans, Louisiana), April 14, 1884.)
[289] Vance, 100.

occurred over the nineteenth century. Col. Merrill wrote, "The removal of the timber that protected the banks has caused them to wash, and the area for the passage of the floods has been increased."[290] As geologists determined that the lack of forests alone could not explain the significant flooding, many bills were introduced to Congress to create outlets, or flood-control reservoirs, along the river for times of flooding. This solution had long been discussed since Engineer Charles Ellett proposed it in 1853, but it continued to grow in consideration despite the recognition that much land would be lost.[291] John Collet, Indiana's state geologist, however, argued that reservoirs would take away so much volume in the river that it would lose its energy and transportation power. In addition, he believed that sediment deposits would increase to the point of making the channel "choked up," which would further increase flood heights. In summary, the reservoirs would make the problem worse rather than improve protections.[292] Despite the opinions of Indiana's geologist, support grew in the suggestion that humans could manage Ohio River flooding through engineering. However, state engineers would have to continue a levee-only policy as support did not lead to appropriations for proposed valley-wide flood control reservoirs.

However, the records of floods prior to recent urbanization and agricultural pursuits made others question the role of human action. "It is hardly wise, therefore, to attach too much importance to the theory of denuded forests, cultivated lands, etc., increasing the volume of floods," wrote Col. R. T. Durrett to *The Courier Journal*. Even more so, the solution to "go back to barbarism by restoring the forests and turning out the cultivated fields to the savage and the

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[290] Wm. E. Merrill. "The Ohio River Floods," *Engineering News* (11), March 22, 1884, 137.
[291] Alstaetter, 39.
[292] Alstaetter, 39; John Collet, Indiana Dept. of Geology and Natural Resources, Indiana. *Report of the State Geologist* (Indianapolis: WM B. Rurford, 1884), 101.

wild beast" was presented as impractical not only because of those seeking profit but also for fear of regression towards the wild in a "civilizing" time. The step backwards was seen as inappropriate given the advances in knowledge. "We must," continued Col. Durrett, "seek a remedy that conforms to the efforts which the arts and sciences are making to adapt the whole face of the globe to the wants of advancing civilization."[293] Although Durrett was a Kentucky lawyer and journalist by trade, he had faith in expertise; he expected that science, and the growing profession of engineering, was more than capable of transforming the river to meet all of the needs of the growing Ohio Valley.

In his writings, Col. Merrill seemed less hopeful than Durrett that an engineering solution could be found for Ohio River flooding. Merrill recognized that the problem lay not so much in a "natural disaster" or simply an "Act of God," but in the lack of planning and preparation for the river's natural fluctuations, which included the water leaving its banks. Cities had grown substantially, especially at the end of the nineteenth century. Land became more valuable along the riverfront, including land that was well known for flooding. The main metric for the damages from flooding became the significant losses of property. Within the growth, the cost of this loss of property increased, justifying arguments for a national government response.

The Ohio Valley residents' reactions to the1880s flooding slowly pushed visions for river engineering in a new direction. Engineering could not simply be limited to helping commerce, but it could help cities and their residents as well. Perhaps engineers could also ensure that the river would no longer negatively impact property along the waterway. In other words, flooding slowly encouraged the growing acceptance of an engineering solution to the consistent flood

[293] "The Ohio River and Its Floods." *The Courier-Journal* (Louisville, Kentucky), March 16, 1884.

threat. The continuation of improving the river channel through increased dredging and the current work of building dams and locks, alongside the selective use of levees, continued as the "best plan" to relieve the valley, as this work would "increase [the river's] discharging capacity."[294]

Colonel Merrill, however, was wary of flood control levees due to cost. "Considering the cost and the taxation that must go with it, I would prefer, if a property-holder in the submerged district, to submit to a quiet rise of the waters rather than risk a levee with its attendant dangers and cost, and its obstruction to business." Merrill's advice was simply to plan for floods instead and establish basic building requirements for houses, such as brick or stone construction and taller second stories. He also emphasized encouraging "laboring people" to move away from the flood-prone areas.[295]

To some extent, flooding already led to a natural movement away from the riverfront. In Cincinnati, as the river's primary purpose had been commerce, a business district built up over the nineteenth century in close proximity to the river. However, as the river's waters regularly overflowed into the shops and buildings, often twice a year, the businesses such as Kroger decided to move away from the riverfront. The city adjusted around regular, average flooding and "adjusted itself as to its real estate values and rents in the flooded zone and to the slowing

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[294] "River Problems." *The Times-Democrat* (New Orleans, Louisiana), April 14, 1884

[295] Wm. E. Merrill. "The Ohio River Floods," *Engineering News* (11), March 22, 1884, 137; While Merrill did not name Rat Row and Sausage Row, he is referring to the poorest of neighborhoods. By the 1880s, "Rat Row" and "Sausage Row," names given by more affluent communities, in Cincinnati had become synonymous with boathands, roustabouts, prostitutes, and poor African American communities. It was considered to be an unstable, less than respectable, and "dirty" area fit for the cities' poorest. Nikki M. Taylor discusses some of these communities during an earlier period in *Frontiers of Freedom: Cincinnati's Black Community, 1802-* 1868 (Athens, OH: Ohio University Press, 2005); "The Cincinnati Public Landing," *Riverview*, Vol. 3, June 1978. Kentucky Historical Society (Frankfort, KY).

down of business during the flood periods."[296] This risk contributed to the city center moving uphill and out of the floodplain in the years following the Civil War.[297] The riverfront became "Rat Row," depicted as a dangerous area that fit the tumultuous riverbanks. Increasingly, most of the Cincinnati's business was unaffected by the yearly flooding and only significant flooding events would harm the city's commerce and place the residents of more affluent community members at risk. This created a problem for those advocating for flood control, as flooding appeared to be an individual rather than a community problem.[298]

Aside from the concern with the cost, efficiency, and factor of being an obstruction in the waterway, Merrill was also concerned with the specific consequences of building such infrastructure. He noted, "even if reservoirs were practicable, they would flood farms, factories, towns and railroads." He believed an annual flood would be better to work around than to build "dangerous devices."[299] A levee would just encourage people to feel more comfortable to move closer to the river, putting them more at risk than before, while harming those already utilizing the land.

Foreshadowing a greater comfort with flood regulation in the coming years, the 1888 River and Harbor Act allowed a small portion of Ohio River improvement funds to be used for flood control, establishing the precedent that improvement efforts by the Army Corps of Engineers were not restricted to the benefit of the military or commercial interests. It stated, "also out of said Ohio River appropriation the sum of fifteen thousand dollars may be expended in the construction, or aiding in the construction, of such an embankment at Shawneetown,

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[296] 1925 Plan, 151.
[297] Raymond Pettit, "Development, Expertise, and Infrastructure Between the Ohio River and Cincinnati Riverfront, 1895-Present," dissertation, The City University of New York (2018), 81.
[298] 1925 Plan, 151.
[299] Wm. E. Merrill. "The Ohio River Floods," *Engineering News* (11), March 22, 1884, 137.

Illinois, as will confine the waters of the river, in great floods, to the general course of its channel, and protect the harbor."[300] As might be expected based on his comments just four years earlier, on August 25, 1888, Col. Merrill recommended in a Corps of Engineers report that the Secretary of War not utilize this allotment for levees, "as its expenditure would have no effect in improving navigation."[301] Merrill was in favor of supporting the town's own work on the levee but seemed to only be interested in helping the town make it safer rather than supporting a comprehensive plan funded by the government. By 1890, Shawneetown had already invested over $231,000 on the embankment.

As a result of nineteenth-century flooding, the federal government's interest, demonstrated by the acts of Congress and the Army Corps of Engineer's projects, became increasingly focused on addressing flooding. Nevertheless, money continued to be funneled toward navigation projects as lobbying efforts continued to be strong. Whether this was due to path dependency or leadership, the priorities of the Army Corps of Engineer rather than individual communities continued to determine the main use and visions for the Ohio River, at least so far as federal investment was concerned. In 1891, Col. Merrill passed away, beginning a new period of leadership in the Army Corps of Engineers. However, the government's reactions to significant floods would not revive old debates on the best flood protection until the first decade of the twentieth century with even larger flooding events.

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[300] United States. Army. Corps of Engineers, *Report of the Chief of Engineers U.S. Army, Part 3* (Washington: Government Printing Office, 1894).
[301] United States. Army. Corps of Engineers, *Report of the Chief of Engineers U.S. Army, Part 3* (Washington: Government Printing Office, 1894).

First great floods of the 20th century: 1907 & 1913 Floods

In February 1907, a flood inundated the Pittsburgh area; approximately 1600 acres that encompassed the central business district and industrial plants were submerged in the flood waters. Business came to a halt for a week, causing a loss of $1.3 million in pay for the city's workers. The flooding also affected Ohio and Kentucky towns. Pomeroy, Point Pleasant, and Henderson were reported as "partly inundated."[302] Another significant flooding occurred in the following month, impacting other portions of the river. A big story came out of Cincinnati concerned the collapse of a two-story brick building that housed Italian immigrants, killing a woman and a child and critically injuring a dozen others.[303] In reaction to this flood event and the next one in 1913, business and professional elites operated through civic organizations, wielding their expertise and influence, to push for flood control. During these two decades, the majority of investment and planning came from the municipalities themselves, but their efforts displayed an increasing willingness to develop permanent flood control.

On February 20, 1908, the Pittsburgh Chamber of Committee established a flood committee to determine the cause of floods and the proper relief for flooding. By 1911, H. J. Heinz, president of the Flood Commission, announced that the completion of first chapter of the commission's report and awaiting approximately $20,000,000 in appropriations from the city, county, and state. One of their suggestions was to return to the idea of a reservoir system, citing that other countries had successfully built reservoirs to control flooding.[304] However, due to the

[302] "Flood May Grow." *The Boston Globe*. Feb 18, 1908.
[303] "Crushed Under Walls of Falling Building." *The Scranton Republican* (Scranton, PA). March 19, 1907.
[304] "Heinz Sounds Flood Warning," *Pittsburgh Post-Gazette*. Nov 5, 1911.

slow pace of the committee's work and local objections, particularly from manufacturers, not much came of the committee aside from relatively small relief efforts before another flood hit.[305]

Old views that navigation benefitted from flooding persisted. Newspapers, even during the flood of 1907, often still noted the commercial benefits of the flooding alongside the stories of devastation. Following the story that ran under the headline "Flood May Grow," *The Boston Globe* titled a section "Good for Coal Shipments," noting that "more than 5,000,000 bushels of coal will be shipped" from Pittsburgh to southern markets. This benefit was "made possible by high river stages."[306] Nationally, old visions for the commercial river could still outweigh the concern for residents.

In March and April 1913, another flood even greater than the 1907 event, swamped the Ohio Valley. A. H. Horton and H. J. Jackson, charged with writing the official government history flood, expressed frustration in the introduction. Reflecting on the numerous recent floods, they claimed, "the problems seem little nearer solution now than they were 50 years ago."[307] Rather than focusing on a narrative as most of the flood summaries from the 1880s, this report contained numerous graphs and calculations, hoping that solutions may be found before the next repeat disaster.

Authors and journalists quickly used the flood's calamity story for profit, and each town carefully recorded the effect of the flood. The Ohio town of Portsmouth was among the most heavily damaged, having lost 80% of the city's structures in the flood waters. Perhaps one of the most devastating aspects of the flood waters was not just the high flow but debris, from bridges

[305] Thomas Rees. "Gives Reasons for Objection: Local Manufacturer Tells Why He Opposes Flood Wall Proposition." *Pittsburgh Daily Post*. Nov 3, 1912.
[306] "Flood May Grow," *Boston Globe*, Feb 18, 1908.
[307] A. H. Horton and H. J. Jackson, 1.

to houses, that the stream carried away and then crashed into other structures. In some places, fires broke out, and debris and oil in the waters fueled secondary disasters.

The 1913 flood raised the question of the Ohio River flooding to the front of conversations concerning the future planning of the river system, even well beyond that of the Ohio Valley. Scientists and engineers increasingly believed that they had to control Ohio River flooding first to address flooding in the Mississippi Basin at large, as it "rank[ed] first in importance in the causation of damaging floods in the larger stream."[308] Several cities in the Ohio Valley followed Pittsburgh in dedicating efforts to preparing for and preventing flood damage. The 1913 flood encouraged the Cincinnati Chamber of Commerce to create the Flood Prevention Committee.

Other local communities hit hard, such as those surrounding the Great Miami River, a tributary of the Ohio, found their local solutions for flood control measures. Engineer Arthur Ernest Morgan formed and led the Miami Conservancy District. This Conservancy revisited ideas that had been developing for over a century and constructed a reservoir system for flood control. This would later serve as support for similar reservoir systems in the Ohio Valley and served as a model for the Muskingum River Valley's fourteen-reservoir system.

Another impact of the 1913 flood was the allocation of state and federal funds to install a stream gauge network to monitor the water levels and flow of the Ohio River and its tributaries. Rather rudimentary, this network consisted of only four stations, but it established the precedent that the river needed to be continuously monitored floods were of national concern and therefore under federal jurisdiction. There were some interesting proposals and conclusions of why

[308] Alfred J. Henry, "Floods in the Ohio River, 1870- 1913," Bulletin/ U.S. Department of Agriculture, 11. Hathi Trust.

flooding seemed to be increasing in height and frequency. For instance, some studies of the riverbanks suggested that the encroachment of buildings and other commercial facilities that extended toward the waterway were not just increasing the damage costs, as Lübken discusses in his work, but increasing the height of flood stages. One engineer concluded that encroachments increased flood stages by ten feet. Others suggested just filling in flooded lands, believing it would solve the problem.[309]

Nevertheless, reflecting on the previous significant floods, district engineer A. H. Horton and assistant engineer H. J. Jackson expressed frustration in 1913 regarding the lack of knowledge regarding floods and base data regarding discharge: "The differences in opinion concerning the treatment of the problem of the improvement of the Ohio have been in the past and are now due chiefly to attempts to draw conclusions from insufficient data and to consider special phases of the subject without attention to other phases." Horton and Jackson called for "systematic studies of all the various factors," but the most vital factor to investigate, they claimed, was that of streamflow.[310] Their goal was to compile all of this data to address the issue of flooding from multiple angles appropriately.

The most important consequence of the costly and devastating floods of 1907 and 1913 was the passage of the Ransdell-Humphreys Flood Control Act of 1917, which appropriated $45,000,000 to controlling floods on the Mississippi, Ohio, and the Sacramento rivers, and for the first time mentioned “flood control” as the primary purpose of an act rather than subsuming it under another goal.[311] Not only would this encourage the engineering of barriers such as levees,

[309] The 1925 City Plan, 150.
[310] A. H. Horton and H. J. Jackson.
[311] Joseph L. Arnold, “The Evolution of the 1936 Flood Control Act”, 3. US Army Corps of Engineers Website.

but it also brought the federal government, which increasingly placed more priority on the Mississippi, more into the affairs of the Ohio. The Mississippi River Commission, not an "Ohio-Mississippi River Commission," would make the recommendations to the Chief of Engineers. For the Army Corps of Engineers though, the priority in the valley would be to continue the Ohio River slack-water system, which turns the river into a water staircase during periods of low and moderate water depth. The engineers designed the locks and dams so that the gates would be opened during flooding to assume a natural river profile and prevent the backing up of waters into communities. However, arguments for flood control management were not sustained for long after both the 1907 and 1913 floods in many communities, and city officials once again put the issue aside in favor of navigational goals. In many urban areas, such as Cincinnati, the riverfront had already shifted to house the less affluent and concerns were on the backburner for officials who prioritized a commercial river, which required access to the river and a different kind of infrastructural investment.

With the significant interest in Ohio River improvement, in terms of locks and dams, proponents of flood control measures attempted to weave the two together as part of a general movement for rehabilitation in river traffic. Cincinnati's Mayor John Galvin said, "Improvement of the Ohio River and the flood prevention work should be carried on jointly if either of the movements are to be successful."[312]

In 1925, *The Official Plan of the City of Cincinnati* recommended the construction of a dike approximately 140 feet wide and 30 feet high in front of the "principal business district,"

[312] "Revival of Ohio River Traffic to be Planned at Conference Called by Mayor Galvin: Improvement of Stream and Flood Prevention Work to be Carried on Jointly." *The Cincinnati Enquirer* (Cincinnati, Ohio), February 16, 1918.

also known as the Central Bottoms, to protect the urban core from flooding.[313] The previous 1922 plan clearly sensed that it was time to re-evaluate the river and stated the river had been "declining since the peak of the river business in 1882." Water transportation enthusiasts believed modern infrastructure would be the answer to the river's revival.[314] While the ongoing construction of locks and dams played into this idea of infrastructure, the question of simultaneously developing the Public Landing with mechanical handling facilities and reliable flood prevention measures was raised as well in defining the "modern river." Reflecting upon a reaction to the 1913 flooding, the Water Supply Paper, No. 334 of the United States Geological Survey stated, "the value of the preservation of damage by floods can hardly be overestimated. It is not to be measured by considering only the value of actual damage by floods in the past." It is not just loss of lives and property that leaders should calculate in flood prevention measures, but the possibility of "increase in the value of property and the enormously valuable increased confidence that would result from the assurance that flood protection up to a certain limit could be absolutely relied upon." In the eyes of the geologists, industries would make the proper economic calculations and move to cities that could provide "immunity." The protection, thus, would become a valuable asset in itself.[315]

The construction of such a dike, it was claimed, "as far as engineering matters are concerned, would not be in any sense difficult." The property of only a few, such as the owners of several buildings "generally of poor quality" and a packet for coaling locomotives, would be affected by the construction. Property in the area proposed was referred to as "of relatively small

[313] "Chapter 9: Waterways and Flood Control," The City Planning Commission. The Official City of Cincinnati, Ohio. The City Planning Commission (Cincinnati, OH), 1925.
[314] "Chapter 9: Waterways and Flood Control," The City Planning Commission, 142.
[315] "Chapter 9: Waterways and Flood Control," The City Planning Commission, 146.

value, and *The Official Plan of the City of Cincinnati* did not dwell on who would be affected beyond coaling and railroad related businesses.[316] The city plan also proposed that the top of the levee have a walking space or a "promenade."

As the Army Corps of Engineers increasingly completed the system of locks and dams, focus remained on the next steps for the Ohio River. The Army Corps of Engineers continued to prepare plans for flood control along the Ohio River. Although the Corps would not build them for decades, the Corps proposed the construction of 88 reservoirs on tributary streams throughout the Ohio Valley in the 1920s, which would reduce the water carried to the mainstem during flood conditions. The Corps predicted this plan would lead to significant flood level reductions for the Ohio River's major cities: 9-13 feet in Pittsburgh, 5-8 feet in Cincinnati and 2-3 feet in Louisville. However, this would not let communities off the hook; cities would still need to approve levees and floodwalls, modify street and highway systems, address potential sewer system back-ups, and create provisions for sewage and surface drainage during floods.[317]

However, the Great Depression would limit the ability of the Army Corps of Engineers to act upon plans. It became clear that the acceptance of flooding as a permanent reality for the Ohio Valley remained consistent. However, the conclusions were that society needed to re-evaluate the location of its communities and the desires of people. As Major Pohl explained, "the location of the walls necessarily brings up the question of evacuating certain areas instead of protecting them."[318] Inevitably, the use of infrastructure to protect the valley at large from floods would create winners and losers. The feasibility to protect a municipality, the economics of

[316] "Chapter 9: Waterways and Flood Control," The City Planning Commission, 152- 153.
[317] Major H. H. Pohl. "Ohio River Flood Control Plan." *American Water Works Association Journal*. Vol. 29, No. 5 May 1937, 593.
[318] Pohl, 594.

doing so, and the sacrifice question needed consideration.[319] If the government was going to foot the bill, the worthiness of individual communities to protect their assets was a national conversation. Flood control efforts would remain within local districts until the Flood Control Act of 1936. This act expanded the federal government's responsibility to include flood control protection, well beyond the focus on commerce, in all of the nation's navigable rivers.

1937 Flood

In January of 1937, a thousand-year flood hit the Ohio River Valley and became the most economically devastating river flood in U.S. history. The Ohio's waters rose to an unprecedented level and crested in Cincinnati at just shy of eighty feet. The flood wreaked havoc for nearly three weeks. One hundred ninety-six counties in twelve states, from West Virginia and down the Mississippi River to Louisiana, found themselves in the direct path of the flooding Ohio; approximately 1.5 million people were affected, including between 500,000 and 1 million driven from their homes and 137 who died. Authorities estimated that one out of every eight Ohio Valley residents were left homeless. The human experience was very similar to that of the 1883 and 1884 floods: residents consistently moved their possessions to higher levels, moved from portion to portion of the city, and modern amenities became unavailable. As with the 1913 flood, fires occurred in industrial areas, adding to the direct calamity. One of the most devastating effects, similar to previous floods, was the loss of farm animals. Official counts of loss include 1,968 work animals, 3,3,54 cattle, 31,516 hogs, 243, 282 chicken, and 11,425 other animals.[320] Water drowned over a thousand towns, and many never returned. The flooding paralyzed the entire valley.

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[319] Pohl, 594.

[320] In terms of economic damage, this flood even exceeds that of the Mississippi flood of 1927. (Lübken, 138).

The timing, only a couple decades after the 1913 flood, may have been a surprise, but the flooding itself was not. In areas outside of the Ohio Valley, particularly along the Mississippi River, flooding continued to menace communities over the two decades. Therefore, the topic of flooding continued to be on the minds of local and federal governments. In April 1937, just months after a devastating flood plagued the Ohio River Valley, the National Rivers and Harbors Congress met to discuss a wide variety of improvements to the nation's rivers. While levees and reservoirs were well in the works, the flood was a testament to the power of the river and "emphasized the need for further flood-control works in that basin."[321] In the past, the Corps put off the widespread construction of reservoirs, leaving the valley vulnerable and eagerly awaiting protection.

Unsurprisingly, the flood rekindled conversations about flood prevention. After the significant flooding in 1927 that hit the Mississippi River communities especially hard, the Flood Control Act of 1927 authorized the Corps of Engineers to complete a comprehensive study of all streams in the country. In 1933, the Federal Engineer Department conducted a study that indicated the possibility of significant flooding in the Ohio Valley. Engineers claimed that Cincinnati could experience a flood stage as high as 83 feet, and four years later, it would indeed experience a new record of an 80-foot flood stage. The report on the Ohio River was submitted to Congress in 1935, and just months before the flood, on June 22, 1936, the Senate and House of Representatives approved $300 million for “levees, flood walls, and drainage structures for the protection” of 12 communities along the river.[322] This act authorized the construction of

[321] “Flood-Control Plan for Ohio and Lower Mississippi Rivers.” 7. Washington, U.S. Govt. 1937. Hathi Trust.
[322] The specific communities mentioned were the following: Paducah, Kentucky; Louisville, Kentucky; Jefferson and Clarksville, Indiana; Lawrenceburg, Indiana; Covington, Kentucky;

individual reservoirs but did not appropriate funds for their construction.[323] The collection of preliminary data and information and planning required considerable amount of work and funds. However, federal funds were only appropriated for actual construction, and the Army Corps retained final say on what could happen in and along the river. The act required municipal governments to purchase property and any city infrastructure changes, greatly delaying work. While public discourse slowly shifted towards the topic of the control of floods, rather than their prevention, the pork barrel legislation would, again, prove to be initially inadequate.

President Franklin Roosevelt had another vision for who would be able to determine the future of the nation's rivers. Much in line with his New Deal plans, Roosevelt believed that the federal government should indeed be the central authority for river alterations. However, as a conservationist, his vision included a specialized bureaucratic organization under the National Resources Committee that would situate flood control within a broader discussion of rational usage of the nation's natural resources. This would upset some local groups, however, as it seemed that not putting flood control at the center of all Ohio River discussions devalued the project. Aware of the pork barrel history of Ohio River legislation, as the first bills came out, the state of Ohio created a document declared:

> We in Ohio and the Ohio Valley oppose any legislation which will not put flood control first and in which flood control and navigation are merely a constitutional subterfuge for securing enactment of a bill and carrying out other purposes. It is quite evident that generation of hydroelectric power, with its distribution through Government and cooperative agencies, is one of the things upmost in the minds of the sponsors of this bill… We insist that protection of life and property in the Ohio Valley should come first.

Newport, Kentucky; Dayton, Kentucky; Cincinnati, Ohio; Manchester, Ohio; Russell, Kentucky; and Coalgrove, Ohio; Welky, 51; House Document 306, 74th Congress.

[323] Pohl, 595.

Ohio also argued that the government should move away from its focus on the Mississippi River and, as the Ohio is a significant contributing factor to its flooding, give the Ohio River flood control "preferential treatment."[324]

The response to the 1937 flood demonstrated that flood control had evolved into a national responsibility. In 1938, President Roosevelt signed the Flood Act that expanded upon the series of acts passed since 1928, which previously prioritized the flood control around the Mississippi River. This new act covered many rivers, but it provided funds for a two-part plan for flood control in the Ohio River Basin: $75,000,000 for reservoirs and $50,300,000 for local flood-protection works such as flood walls.[325] Protecting the Ohio River communities in "one of the most extensively developed regions in the United States" was important but, as a tributary and principal contributor of floods on the Mississippi River, so was reducing the possibility of significant flooding downstream.[326]

The navigation system of locks and dams, created just a decade prior, generated interest and faith in the re-engineering of the river. Like these projects, the flood control proposals would address problems that had long been a reality of living near the river and would create another layer that would require consistent investment and management. Decades later in the 1970s, many reservoirs would be built in the Ohio Valley, creating new habitats and ecologies. For instance, the Army Corps of Engineers built many of the lakes in southern Ohio such as Caesar Creek Reservoir in Waynesville, Harsha Lake at East Fork State Park, and Brookville Lake in Indiana under the Flood Control Act of 1938 to control flooding in the tributaries and,

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[324] "Ohio's interest in flood control," 5.
[325] Public No. 761- 75th Congress. Chapter 795-3rd Session. H.R. 10618.
[326] "Flood-Control Plan for Ohio and Lower Mississippi Rivers." 4. Washington, U.S. Govt. 1937. Hathi Trust.

consequently, mainstem of the Ohio River. While serving as recreational meccas for residents and visitors alike, these man-created lakes set up a whole new set of issues and more intimately connected lands within the basin but far from the river to the Ohio River itself. Although Ohio has virtually no natural lakes aside from Lake Erie, the state has become well-known for its water recreation, altering how people viewed the natural landscape.

What was the nature of flooding along the Ohio River that required such extensive reworking of the landscape far beyond the river's banks and the creation of artificial reservoirs that would permanently alter the landscape and even sacrifice small towns and farmlands to the greater good of "flood control"? How were winners and losers determined, and what were the priorities of local communities and the federal government in determining a new period for the river?

Devastation following the 1937 flood led to decades of political and engineering work to control and minimize the destruction of flooding in the Ohio Valley. Although Congress quickly approved funds, the exact plans were debated, and the actual work would take decades despite the quick project approval and public support. Congress approved 76 reservoirs, but other priorities such as war mobilization took precedent and almost twenty years and $500,000,000 later, only thirty-three reservoirs were complete.[327]

Flood control solutions were a contentious issue for some locations along the river, such as Cincinnati. Leaders revisited old debates on walls versus a system of reservoirs and dams. Ohio Representative James G. Polk became concerned after the House expanded the Ohio River flood wall project. While he was in support of the wall that would protect the counties along the

[327] "Despite Progress, Ohio River Flood Control Still Has a Long Way to Go." *The Courier-Journal* (Louisville, Kentucky), January 8, 1956.

river, he urged it "should not be considered as a substitute for dams and reservoirs at the headwaters of our streams but should supplement and dovetail into a comprehensive flood control program."[328]

The flooding of 1937 began a new phase for the Ohio River, as each city previously responded to the threat of significant flooding a little differently. Anthropologist Raymond Petit referred to this event as a "critical juncture in the region's relationship with flooding."[329] Many cities decided to use the federal government's funds earmarked for flood control. However, there was a wide range of opinions. A city could build a levee or a floodwall, but this would mean generally blocking off the river. In a city like Cincinnati that used its riverfront, reminiscent of the debates of the nineteenth and early twentieth century over altering the river, this would become a contested issue between those who wanted to work around the river's cyclical nature and those who saw this proposition as unlikely to preserve development.[330]

Over the 1930s, lobbying groups around the Mississippi River convinced the U.S. Congress that rivers were a national priority, meaning that flood control was a national rather than local matter as traditionally viewed outside of navigational issues.[331] By 1938, Cincinnati officials seriously considered that a proposed viaduct that consolidated transportation improvement and flood prevention efforts.[332] Congress also revisited earlier flood prevention infrastructure. For instance, in 1940, Congress considered a plan that would construct a high-

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[328] Earl Berkley. "Ohio River Flood Wall Project may be Expanded by the WPA." *Washington Court House Record-Herald* (Washington Court House, Ohio), April 20, 1938.
[329] Pettit, 79.
[330] Pettit, 79.
[331] Pettit, 81.
[332] "Contract on Viaduct Voted as Terminal Proposal is Accepted by City: Long- Contemplated Project on Sixth Street to be Started by January." *The Cincinnati Enquirer* (Cincinnati Ohio), October 14, 1938.

level flood control dam below Portsmouth, Ohio, or Greenup, Kentucky. Response to new plans remained controversial for various reasons. In Portsmouth, much of the controversy revolved around the issue that the plan would destroy over 9,000 acres of corn land and required costly investments in the water and sewage systems.[333]

After federal funds and decisions made in the aftermath of the 1937 flood, communities within the Ohio River drainage lost significant autonomy. The valley gave up their ability to single-handedly alter any streams within the basin and, instead, they had to take proceed with precaution by contacting the state conservation department that worked closely with the Army Corps of Engineers, as any alteration needed to have "due regard for the entire [river] basin plan." Even as far north as Indianapolis, cities could not create their local flood control projects to address the overflow of tributaries.[334]

Given the extent of the damage of the 1937 flooding, it is fascinating how little historians have focused on the event. As one historian, David Welky, put it, "the 1937 flood is a catastrophe lost to historians."[335] Much of the historiography on the flooding has focused, to some extent, on risk. In his preface, Welky asked the question, "Had it never occurred to anyone that building a city next to a thousand-mile river carried risks? Had no one taken precautions against the inevitable?"[336] Uwe Lubken also addresses this question in his work on river assessment along the Ohio River. Much of the answer lies in priorities. Many previous floods were also devastating, but the benefits of being near the river outweighed the risks. As other

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[333] "Flood Control Dam Proposals Being Studied." *The News- Messenger* (Fremont, Ohio), February 29, 1940.
[334] "Riverside Job." *The Indianapolis News* (Indianapolis, Indiana), January 17, 1939.
[335] David Welky, *The Thousand-Year Flood: The Ohio-Mississippi Disaster of 1937* (Chicago: University of Chicago, 2011), xi.
[336] Welky, iv.

forms of transportation rose, engineers transformed the river to compliment the greater range of demands on the river.

By the 1930s, Ohio Valley residents widely accepted that the Army Corps had control of the river and any alterations. In the Ohio Chamber of Commerce's response to flood control proposals, the Board announced, "the proper agency to survey, plan, let contracts for, and supervise the construction of these projects is the Army Engineers," and the "whole expense should be borne and the authority vested in the Federal Government."[337] Due to the costs of research and building costs for protection, communities came to realize the federal government would increasingly need to play a role in flood control. As historian David Welky claimed, "Discussions about preventing future superfloods assumed that Washington, not the states or private interests, bore primary responsibility for shielding citizens from natural disasters."[338] Therefore, "legislation, physical structure, attitudes about coexisting with natural forces, the very parameters, for how one lives alongside the river all reflect the New Deal World."[339]

While the federal government would funnel resources through local charities and organizations such as the local chapter of the Red Cross, it was widely understood that the New Deal programs allowed for extensive flood relief efforts as determined necessary, designed and implemented by the Army Corps of Engineers. These programs led to the Ohio River, once again, being defined as a national river- even if the federal government was acting to protect the local assets. Therefore, the thousand-year flood in 1937 served as both a sign that humans must change their relationship with the environment and reinforced long-developing ideas regarding federal control of the Ohio River. The Ohio Valley gained protection from floods that gained in

[337] "Ohio's Interest in Flood Control." Hathi Trust.
[338] Welky, 8.
[339] Welky, 9.

intensity, but increasingly, residents would voice their desires to have control over another issue: pollution abatement in the region.

Chapter Five:

Regional Solutions to a Common Problem:
The creation of the Ohio River Valley Sanitation Commission

The relationship between human communities and the Ohio River grew increasingly complex during the early to mid-twentieth century, and not every river community shared the same view and experience. Pennsylvania, West Virginia, and Kentucky arose as significant players in the nation's coal industry. Meanwhile, no longer a direct a resource for extractive industries, the "Beautiful Ohio" took on other roles for communities downstream. In Cincinnati, the river provided water for the city's municipal and industrial consumption and assumed a stronger role as a recreational and aesthetic asset. Between the reduced commercial role and river traffic and the population growth of the region, the Ohio River grew in importance as a site for leisure and recreation. It was a site for the community to come together for swimming and picnicking at designated public beaches. With this new role, general concern with filth and illness moved away from that of the cities' sewers and dirty streets and towards the main artery of the valley: the Ohio River itself. Cincinnati's municipal efforts to address stream pollution provides insight into this shift toward thinking of the city as part of a larger community defined by a river basin.

By the early years of the twentieth century, beloved sources of entertainment developed along Cincinnati's portion of the Ohio River. The shallow water and natural sandy riverbanks and acceptance of gambling in Newport, across the river, contributed to the creation of prosperous resorts and the Greater Cincinnati's nickname as the "Atlantic City of the West."[340]

[340] William Croyle, "100 Years Ago, River Was Clear, Sand White," *Cincinnati Enquirer*, July 29, 2003.

Such river activities included recreational boating, fishing, and swimming.[341] Directly across the river from the city, bathing beaches in Kentucky, such as Queen City Beach in Bellevue and the Princess, Manhattan, Berlin, Gem, and Tacoma beaches in Dayton, became popular destinations of amusement for individuals and families, especially during the summer months. On average, the beaches attracted as many as 7,000 to 8,000 bathers on the weekends and were important gathering places for celebration. Coney Island, a prominent resort on the Ohio side of the river, attracted about 300,000 visitors for its Fourth of July celebration alone.[342] The rise in these beaches suggests that the river in the early twentieth century increasingly became accessible to residents, but the commercial history of the river lived on through symbols.[343] At the Queen City Beach, the steamboat, *Island Queen*, was prominently staged for its visitors; thus, the beaches played upon the river's role in the city's commerce and proudly displayed as a piece of the

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[341] "Ohio is 'River Beautiful!': Unsurpassed in World, Says Explorer and Traveler on Boat Trip to Record Scenic Wonders," *Cincinnati Enquirer*, May 15, 1925, 11.
Commercialization of recreation and leisure is a common theme in the United States during the late nineteenth and twentieth centuries. One of the earliest social histories on the top is the following, which focused on Coney Island's role in creating a new mass culture, bringing about social and cultural change: John F. Kasson, *Amusing the Million: Coney Island at the Turn of the Century* (New York: Hill and Wang, 1978). This historiography has continued to grow with social history. Books that followed Kasson's work include: Lawrence Culver, *The Frontier of Leisure: Southern California and the Shaping of the Modern America* (Oxford: Oxford University Press, 2010); John Sterngass, *First Resorts: Pursuing Pleasure at Saratoga Springs, Newport and Coney Island* (Baltimore: The John Hopkins University Press, 2001); Gary Cross and John Walton, *The Playful Crowd: Pleasure Places in the Twentieth Century* (New York: Columbia University Press, 2005). This literature has also expanded into understanding other places for swimming, outside of public beaches: Jeff Wiltse, *Contested Waters: A Social History of Swimming Pools in America* (Chapel Hill: University of North Carolina Press, 2007).
[342] "Coney Island's Big Crowd: Three Hundred Thousand at the Popular Resort," *New York Times,* July 5, 1894, 9.
[343] Joel Tarr discusses rivers around Pittsburgh becoming more accessible to residents during this period but often, in reaction to the growing built environment, what he calls an "unsightly and unnatural" manner. However, this is an instance where residents enjoyed a relatively unnatured river, actually experiencing the water and environment without barriers. (Tarr, 23).

Cincinnati experience.[344] Newspapers, leaders, and citizens of the region painted a picture of Cincinnati as an interior paradise for residents and visitors alike, centering their prospect on the beautiful and affluent Ohio River.

In reality, Cincinnati's waters were far from this professed paradise. The Cincinnati and Ohio governments, as well as ordinary citizens, increasingly realized this discrepancy in the 1920s. Upstream municipal and industrial pollution and Cincinnati's waste damaged the Ohio River mainstem and tributaries and property placed in the river, such as the Army Corps of Engineers' new locks and dams.[345] However, the Corps had to begin studies to define the extent of this pollution other than empirical evidence.[346]

There seemed to be no quick and easy solution to the Ohio River pollution, however, to make reality fit the beautiful river image. Late nineteenth-century efforts to control the dumping of sewage, garbage, and industrial waste had little effect. Historically along the river, same as most other major rivers in the world, cities and industries dumped untreated waste into the Ohio. As populations grew, this old method of dilution became outdated and insufficient to ensure the health of the public and environment.[347] This standard practice was not only imprinted on the

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[344] "Bellevue Beaches," Northern Kentucky Views, accessed January 23, 2014, www.nkyviews.com/campbell/bellevue_beaches.htm.
[345] Charles Brooks Smith, "Washington News Gossip," *The West Virginian* (Fairmont, WV), September 8, 1921.
[346] "Pollution of the River to be Studied: Investigation of Ohio and Tributaries May Be Resumed July 1, After Temporary Suspension," *The Cincinnati Enquirer*, April 30, 1919.
[347] Martin V. Melosi is a leading scholar on the topic of sewage treatment systems and waste in cities. His most applicable work to this topic is the following: Martin V. Melosi, *The Sanitary City: Environmental Services in Urban America from Colonial Times to the Present* (Pittsburgh: University of Pittsburgh Press, 2008). Melosi expanded on some of his earlier works, such as *Pollution and Reform in American Cities* (1980), to create this new comprehensive monograph. *The Sanitary City* explores the relationship between cities and their environment. His chapters on the bacterial revolution are helpful in understanding the rise of public refuse programs during the same period of this study, 1880 to approximately 1920. Melosi saw a slow broadening of the

river's ecology and surrounding landscape but on public memory as well. Decades later, in 1943, *The WPA Guide to Cincinnati* made a point to cite that in the past "the river spewed all kinds of human debris into the city."[348] This waste accumulated in the river as its water travelled from one city to the next, increasingly creating environmental and human health problems for the cities downstream. Natural processes of decomposition, especially in the case of chemicals, simply could not keep up as communities expanded and industries increasingly concentrated in the Ohio Valley. Each municipality blamed the one upstream for the polluted water, relinquishing responsibility for the contaminated resource. Cincinnati denounced the cities of Pittsburgh and Portsmouth, among many others, for failing to control their output of waste; meanwhile, Louisville, Evansville, and Cairo included Cincinnati in their lists of offenders in adhering to an unofficial good neighbor policy.[349]

During the early twentieth century's progressive era, city planners generally believed that improved environments, through the alleviation of pollution and other physical and health threats, would lead to better, more organized and controlled societies. This conviction encouraged improvements aimed at creating a comprehensive, public, citywide and permanent system to deliver sanitary services at the local level. Cities could either direct their waste to an undesirable parcel of land just outside of the city, as Cincinnati had done with Mill Creek valley,[350] but directing it towards a river was ideal as it provided a natural flushing system.

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views surrounding pollution and the cities' role in addressing the growing public health concerns.

[348] The Cincinnati Historical Society, *The WPA Guide to Cincinnati* (Cincinnati: The Cincinnati Historical Society, 1943), XXXIX.

[349] Allen Deiterich-Ward, *Beyond Rust: Metropolitan Pittsburgh and the Fate of Industrial America* (Philadelphia: University of Pennsylvania Press, 2016).

[350] Stanley Hedeen, *The Mill Creek: An Unnatural History of an Urban Stream* (Cincinnati: Blue Heron Press, 1994).

Sanitation reform through the addition of public sewage facilities in urban Western societies such as Germany, England, and the United States greatly improved sanitary conditions, but again, the prevailing thought was to prevent disease by flushing dirt, foul odors, and filth away from a specific urban population.[351] Rather than ridding the sewage of its harmful qualities, municipalities directed the wastes to the river, with little or no thought about what this meant for communities downstream. These efforts did very little to address problems that were regional in nature, such as river and stream pollution experienced in the Ohio Valley. Rather, these improvements only aggravated the situation in the region because greater amounts of domestic wastes were directed to the river as each city extended its sewerage systems.[352] River cities invested large sums of money in sewage facilities in the late nineteenth and early twentieth centuries. Cincinnati alone invested over $3,000,000 in sewer construction during the 1910s.[353] The methods of waste disposal and lack of regional cooperation, though, stunted the Ohio Valley's ability to adequately address the growing pollution problem.

Responding to pressures from downstream communities to reduce their pollution output, upstream municipalities developed ways to avoid acting in the interests of the entire valley. One of these attempts was Ohio's 1908 passage of the Bense Act. This law decreed communities were not required to treat wastewater before dumping it into waterways unless *every* municipality upstream had done so. Kentucky and West Virginia technically had jurisdiction of the river, and Ohio felt that, without jurisdiction over the river, any attempts to require

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[351] Michael Neuman and Sheri Smith, "City Planning and Infrastructure: Once and Future Partners," *Journal of Planning History* 9 (2010): 24.
[352] M. V. Veldee, "An Epidemiological Study of Typhoid Fever in Six Ohio River Cities," *Public Health Reports* 46, no. 25 (1931): 1463.
[353] Hedeen, 104.

communities and industry to treat wastewater would be unjust and fruitless.[354] By the 1920s, the cherished Cincinnati beaches began to close due to the ubiquitous presence of sewage in the waters, and fishermen experienced considerable difficulties.[355] Fish, let alone healthy fish, became scarce, and the leisure activity of fishing was less appealing in filthy streams.[356] For Cincinnati, the only viable plan to address the pollution in the river was through direct cooperation with its neighbors.

The state of Ohio's inability to address these public health problems was not the only issue the Greater Cincinnati area Ohio River Valley faced in conserving the river. In efforts to conquer nature and engineer a more predictable flow, an entity of the federal government, the U.S. Army Corps of Engineers, drastically altered the Ohio River through canalization and various flood control measures between the 1880s and 1920s. While locks and dams greatly assisted commerce, the Corps decelerated the water's velocity and transformed the river into a series of slack-water pools.[357] This tended to localize pollution near its source.[358] Concentrating on the goal of easier and reliable navigation, inadvertently accentuated the Ohio River's pollution problem.

By the beginnings of the 1920s, communities along the Ohio River could not ignore the changes within the river. Businesses were forced to close, and recreation was hindered

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[354] "Minutes of Meeting Held at Neil House, Columbus, November 22, 1937, 2:00 PM," Presiding: Mr. W. F. Wiley, Chairman, Department of Health Central Files 1936- 1965 (Water Resources), Series 1434, Box 53526, Folder: 1936 Stream Pollution Commission, The Ohio Historical Society, Columbus Ohio.
[355] "Sewers Imperil River Bathers," *Cincinnati Enquirer*, August 17, 1917, 14.
[356] The Izaak Walton League took considerable interest in the pollution and health of the Ohio River; "Stream Pollution Puzzle to Health Authorities," *The Journal News* (Hamilton, Ohio), June 23, 1926.
[357] Rhodes, *The Ohio River*, 45.
[358] Cleary, 17.

significantly. The Ohio even no longer resembled the river once known to the valley. Besides the increase of sewage in the water, the water level varied less season to season, and the sands were quickly covered in mud. Nevertheless, the changes generally appeared, in theory, to benefit the communities they affected. It made little sense to oppose the improvements unless a general consensus, not only within a municipality but also within the entire region, arose that the pollution issue would need to be addressed. It would not be until 1934 that a movement emerged out of Cincinnati, spearheaded by businessmen, to tackle the larger pollution issue amongst the states in the Ohio River Valley on an unprecedented scale.

Early Efforts through the 1920s

With the rise of bacteriology, cities in the late nineteenth century increasingly turned their attentions towards issues of sanitation and creating permanent, comprehensive public sanitation systems. Industrialization led to a variety of tools, from pipes to wires that municipal engineers could use to deliver sanitation services and transform American cities. Pure water became a significant goal and cities across the Ohio Valley, like their eastern and European counterparts, created sanitation commissions to protect their cities from the risk of disease. Such efforts fell in line with the strand of progressive reform that called for widespread urban environmental reform. Increasingly, reformers connected urban problems with the environment, and pollution became a major target by the early twentieth century.[359] Nevertheless, concerns for areas outside of the city were not a priority of municipal health departments. At the beginning of the twentieth century, this shifted as health and sanitation departments began to meet to discuss what, increasingly each began to realize, was a common problem: the sanitation of the Ohio River.

[359] Melosi, 71-75.

In 1905, in response to the typhoid epidemic in urban communities, Pennsylvania established the Purity of Waters Act to regulate sewage discharge. Part of the state's plan initiated a water quality management program and a program for the selective permitting of industrial wastewater. It also led to the creation of a state Department of Health and gave it jurisdiction over public water supplies and pollution.[360]

As early as 1908, the same year as the passage of the Bense Act, representatives from Ohio, Pennsylvania, and West Virginia met to discuss the work each state had undertaken to protect local streams against pollution.[361] Each state had its own stream commission, but this was one of the first efforts for the neighbors to meet and brainstorm solutions. At a meeting held in Wheeling, West Virginia, on May 18, 1909, Judge H. E. Corn of Ironton, Ohio, recommended that all legislatures adopt a law "to prevent the introduction of any additional sewage into the Ohio River or into any of its tributaries which affect the public water supply of *any* municipality." This was key, as the prior year the Ohio state legislature exempted every municipality along the Ohio River from installing sewage-treatment works until comparable facilities were provided by all municipalities upstream from it. Corn's suggestion meant that even Ohio would be held liable to treat its wastewaters, as much as Pennsylvania and every other upstream state. However, nothing came of his suggestion other than simply more recognition of the problems upstream communities caused for those downstream.

Other than general understandings and a few minimal scientific studies, the state-level leaders knew very little about the extent of the river's diminished health. The first step in

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[360] Pennsylvania Department of Environmental Resources. "75 Years of Clean Streams Progress: Highlights of the Commonwealth of Pennsylvania Clean Streams Program, 1905 to 1980." September 1980. Gail Rockwood Papers, 1970-2000. University of Pittsburgh archives.
[361] Ohio, Pennsylvania, and West Virginia collectively referred to this group as the "Ohio River Sanitary Commission."

controlling the river's water level and flow, and now in the instance of the river pollution, the next step was to accumulate scientific, professional knowledge. Therefore, the leadership first attempted to understand the severity the Ohio River pollution. The relatively informal group discussed a survey study of the river at the 1909 meeting in West Virginia. Pennsylvania's chief engineer, Herbert Snow, committed the health department to investigate the limited boundaries of his state, while Ohio agreed to survey the river up to Cincinnati.[362] The following year, the joint commission hired an engineer to create a preliminary report on the cost of sewage purification in Cincinnati. By 1911, the Ohio Board of Health began an education campaign in towns along the river, "for the purpose of arousing public interest in the matter of the protection of the Ohio River against pollution."[363] The health departments understood the hazards of water pollution for public health and began tackling the issue to the best of their ability. Nevertheless, the Ohio Valley states did not pass extensive legislation and much of the action remained within the health departments. The states created no permanent, strong structure, and national and local groups were rarely involved in the planning and implementation process.

In the early 1920s, drinking water taken from the Ohio began to smell and taste strange to residents along the river. Several states' health departments responded by handing the issue over to the federal government. They informed the United States' Public Health Services of their concerns related to the disposal of a particular chemical resulting from coke processes and oil

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[362] Snow was the Chief Engineer of the Pennsylvania State Department of Health; Ohio Department of Health, "May 18, 1909, Minutes of the Joint Meeting of the Ohio River Sanitary Commission with Representatives from the States of Pennsylvania and West Virginia," Memoranda- Ohio River Interstate Steam Conservation Agreement, Department of Health Central Files 1936-1965 (Water Resources), Series 1434 Box 53526, The Ohio Historical Society, Columbus, Ohio.

[363] *Ibid*, " October 18, 1910, Meeting Minutes of the Ohio River Sanitary Commission. Memoranda- Ohio River Interstate Steam Conservation Agreement"

refining referred to as phenolic wastes.[364] Within the next two years, the U.S. Surgeon General called together representatives from the Ohio Valley for two national conferences in Washington D.C. to address their concerns and potentially create some form of organization to address the phenol problem between the states.[365] An organization against phenol wastes was created with the Ohio Department of Health's director of health, Dr. John Monger, as its chairman. Demonstrating that the phenol organization was mostly a national government endeavor, the group's secretary wrote to every state's department of health asking for statements of attitudes about participation in and cooperation with this organization.[366] It was uncertain that any of the states would participate in addressing, or were even concerned with, the river's pollution issue.

While these arrangements were taking place amongst states and the federal government, states and cities attempted to address municipal and industrial wastes on their own. A year after Pennsylvania established its Sanitary Water Board, the state's Department of Health also created a Tannery Waste Committee. This committee set the precedent for the state to monitor other

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[364] *Ibid,* "The Water Supply of Cincinnati"

[365] In 1923, the U.S. Surgeon General called together representatives from these states for a conference in Washington D.C. to discuss these concerns. Eleven states attended, among these were Ohio, Pennsylvania, and West Virginia. Later the same year, Ohio's Department of Health gathered ten industries, which produced phenolic wastes in Cleveland, Ohio, and concluded that the waste problem could only be handled "by concerted action on the part of the several states having the same problem." Afterwards, Director of Health, Dr. John Monger requested that the Surgeon General once again call a national conference to create some form of organization to address this problem between the states. A total of ten states, including the Ohio Valley states of Pennsylvania, Ohio, West Virginia, and Kentucky, attended the conference on January 19, 1924.

[366] Ohio Department of Health, "Historical Resumé of Actions Leading to the Adoption of the Ohio River Interstate Stream Conservation Agreement and Organization of the Ohio River Board of Engineers," November 23, 1932, Department of Health Central Files 1936-1965 (Water Resources), Series 1434 Box 53526, The Ohio Historical Society, Columbus, Ohio

industries, such as the pulp and paper, coal mining, petroleum, textiles, gas, and metallurgy industries.[367]

At a meeting on April 14, 1924 in Pittsburgh, only three states' chief engineers (Ohio, Pennsylvania, and West Virginia) attended and participated in drafting an interstate agreement, the "Ohio River Interstate Stream Conservation Agreement," that was officially signed in November of that very year. However, rather than the agreement being among the states or cities themselves, which did not equally have legal status in these matters, it was an agreement among the health departments, without the backing of any state legislation. While the original intent of the agreement was to correct the phenolic waste troubles, it created a uniform policy for dealing with all *industrial* byproducts. Within the next two years, supplement agreements were added that extended the arrangements to apply to Kentucky, New York, Maryland, Illinois, Indiana, and Tennessee. By 1928, the Ohio River Interstate Stream Conservation Agreement consisted of eleven states.[368]

The Ohio River Interstate Stream Conservation Agreement created a "Board of Public Health Engineers of the Ohio River Basin" that would meet at least once a year to specifically discuss phenols, a by-product of the coke-making needed for the steel industry and when it's added to water, will alter its taste and create an offensive odor.[369] The signatory states were required to "promptly institute action to require… elimination or removal [of phenol and other tarry acids] by suitable treatment prior to discharge" and to notify states downstream of any

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[367] Pennsylvania Department of Environmental Resources. "75 Years of Clean Streams Progress: Highlights of the Commonwealth of Pennsylvania Clean Streams Program, 1905 to 1980." September 1980. Gail Rockwood Papers, 1970-2000. University of Pittsburgh archives.
[368] *Ibid*.
[369] Jack Vincent, "Armco Tests Plant to Free Streams of Phenol Waste: Anti-Pollution Experts Hail Work As Big Step to Restore Rivers," *The Journal Herald* (Dayton, Ohio), November 16, 1949.

unusual events along the river, such as spills and disease outbreaks. The members of the Board also exchanged research on policy and discharge of wastes, for the benefit of all involved states. Inspections of one another's water works, polluted streams and tributaries, proposed remedies for pollution, and board arranged reports.[370] However, the agreement to address phenols had several potential obstacles in complete pollution abatement and cleaning up the Ohio River. First, the group did not clearly define and describe the sewage treatment requirements for municipalities; rather, limits were placed only on industry.[371] More importantly, though, the efforts failed to create an equal and permanent structure amongst the states to discuss pollution in general and adequately pull powers together to enforce the necessary regulation to protect and conserve the Ohio River's health and enforce the necessary regulation to protect and conserve the Ohio's ecological health. Nevertheless, phenol levels decreased for the time being, as between 1924 and 1927 the joint efforts reduced the number of plants that discharged phenol wastes into the river from seventeen to only four.[372] Fears largely subsided until another threat arose and spawned a new sense of urgency.

The Early 1930s

A drought in 1930 and another that followed in 1934 once again raised the issue of cooperative pollution abatement among the Ohio Valley states.[373] By 1930, many cities along the

[370] Tributaries are streams that flow into the main stem. In this case, the main stem would be the Ohio River itself.
[371] Ohio Department of Health, "Ohio River Interstate Stream Conservation Agreement of November 27, 1924, and Its Three Supplements," Department of Health Central Files 1936-1965 (Water Resources), Series 1434 Box 53526, The Ohio Historical Society, Columbus, Ohio
[372] Authur Miller and H. W. Streeter, "Chloro-Phenol Tastes and Odors in Water Supplies of Ohio River Cities, *American Journal of Public Health*, 19, no. 8 (1929): 930.
[373] Most states and industrial sites did not need to be "compelled" to create phenol treatment works. ("The Water Supply of Cincinnati"); "Two Droughts Forced Water Compact," *Cincinnati Post*, June 28, 1948, 17.

river had not developed sewage treatment facilities, as they were not required to do so, and the low flow periods during drought resulted in problems for municipalities, such as Cincinnati, which relied on the river for palatable and safe drinking water.[374] Drought conditions resulted in the stagnation of water behind the Army Corps' dams for at least a period of ten months.[375] These pools became virtually open cesspools.[376] River conditions forced Congress to distribute about $2,000,000 to state and local health departments in emergency relief health work in 1931, as epidemics of gastroenteritis spread along the Ohio Valley.[377] The first rise of the river aggravated the water purification issues by overwhelming the few existing treatment facilities; often, raw, untreated sewage managed to completely bypass the system.[378]

In the case of Cincinnati, the city spent several millions of dollars on improving its sewage system in the previous two decades. Per the Ohio State Board of Health's 1913 sewage plan, Cincinnati built several interceptors and planned for treatment plants. However, when the

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[374] According to Chief Engineer Waring, this was due to poor financing, as cities had difficulty finding funds to create and maintain such works. ("The Water Supply of Cincinnati"); Around 1907, the water intake for Cincinnati was relocated to a point on the Ohio River 8 miles above the city and about .75 miles above where the Ohio River meets the Little Miami River. This water was pumped into two large reservoirs that held about 340 million gallons, or six days' worth of water. It was assumed because of the size of the reservoirs that natural processes would separate out most of the silt and bacteria from the water; therefore, the reservoirs would only need to be cleaned every four to five years. ("The Water Supply of Cincinnati")

[375] "Minutes of Special Meeting of Health Commissioners Signatory to the Ohio River Interstate Stream Conservation Agreement," Department of Health Central Files 1936-1965 (Water Resources), Series 1434 Box 53526, The Ohio Historical Society, Columbus, Ohio.

[376] Cleary, 23.

[377]Ohio Department of Health, "Memorandum Re Meeting With Surgeon General and Public Health Officials of Twenty- One States in Drought Area," February 10, 1931, Memphis, Tennessee, Department of Health Central Files 1936-1965 (Water Resources), Series 1434 Box 53526, The Ohio Historical Society, Columbus, Ohio; Such cases of gastroenteritis appeared in Cincinnati in January, 1931 (p.23, The ORSANCO Story).

[378] Ohio Department of Health, "Minutes of Special Meeting of Health Commissioners Signator to the Ohio River Interstate Stream Conservation Agreement," Department of Health Central Files 1936-1965 (Water Resources), Series 1434 Box 53526, The Ohio Historical Society, Columbus, Ohio.

droughts hit, the construction of the treatment plants for the Duck Creek, Mill Creek, and the Ohio River areas were still not completed.[379] By 1934, the bacterial count in the Ohio River skyrocketed as more upstream municipalities directed their wastewaters directly to the Ohio instead of just outside city limits. Cincinnati had to moderate the problem with no permanent treatment facilities to adequately sanitize its water.[380]

According to Ohio Chief Engineer F. H. Waring, Kentucky was actually in better shape than Cincinnati, despite having no plants for the development of intercepting sewers. This is because Cincinnati's plans were based on the river's height and flow in 1913, but by 1932, the Army Corps of Engineers considered reconstructing "Dam No. 37."[381] Their plans raised the water elevation by 15 feet, destroying most of progress on the city's sewage system projects.[382] This reveals a lack of communication between the Army Corps of Engineers and local planning that had the potential to ruin a multi-million-dollar investment by Cincinnati. In addition, though,

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[379] The 1910 study of Cincinnati resulted in the adoption of a new general sewage system plan by the State Board of Health in 1913. The health board divided the metropolitan area into three concentrated sewage treatment and disposal flows. These three were the Duck Creek area (drained a portion of Cincinnati and Norwood that laid north and east of the tributary to the Little Miami River), Mill Creek District (drained the western and northern portions of Cincinnati, as well as several surrounding suburban communities), and the area around the Ohio River (constituted most of the downtown Cincinnati), which directly drained into the main stem of the river itself.[379] By 1932, the Duck Creek interceptor and most of the Mill Creek interceptor were completed and in service.[379] However, no work began on the Ohio River interceptor and all three lacked *permanent* sewage treatment facilities; Plans for temporary sewage treatment plants were in the works in the Little Miami Valley to address the Duck Creek area and near the mouth of Mill Creek for partial treatment of the Mill Creek wastes. A couple pump stations were planned for the Ohio River District downtown also, which moved the flow to the temporary Mill Creek treatment works. A discussion even took place regarding moving the Ohio River interceptor downstream to the Great Miami River. This would take the pressure off of the downtown area and, instead, move the wastes generated outside of the most important and productive portion of the city.

[380] Cleary, 24.

[381] Located in Fernbank, 13 miles below the center of Cincinnati.

[382] "Memorandum on Plan of Sewerage and Sewage Disposal at Cincinnati, April 18, 1932"

the federal dam and navigation projects actually aggravated the pollution problems of the region. The dams caused unnatural pools of water, which provoked unpredictable complications for sewage treatment facilities. Cincinnati experienced a situation in which local planning, without extensive communication with the federal government, practically negated over two decades of work and investment. The city was left unprotected and vulnerable.

In November of 1931, a phenolic waste spill occurred at a coke plant in Youngstown, Pennsylvania. While accurate numbers of the phenolic contents that entered the waterway are unclear and newspapers did not report on the story, perhaps an indication of how accidents were relatively common, the state took action to notify downstream communities. As required by 1928 Ohio River Interstate Stream Conservation Agreement, the district notified all municipalities located downstream. Notification, though, could not protect residents from the impact of contaminated water. Within fifteen days, Cincinnati experienced phenolic tastes in its water supply, which continued for about two weeks. On top of this issue, the river water tested to be the hardest since filtration began in 1907.[383] When called in to respond to the situation, Chief Engineer Waring concluded the low flow caused extremely nominal dilution, concentrating bad tastes present in the water. The cold, winter weather accentuated the offensive "phenolic," "saline," and "river" tastes as well. For Waring, the answer for the city and others was to adopt additional new treatment facilities, as planned, to relieve such problems.[384] Nevertheless, it became more apparent to some states that the federal government needed to step in with

[383] Hardness refers to the amount of minerals in the water.
[384] Ohio Department of Health, "Memorandum on Occurrence of Phenolic Tastes in Water Works Intakes of Ohio River Basin During November, December, and January" January 13, 1931, Ohio River Board of Engineers Correspondence, Department of Health Central Files 1936-1965 (Water Resources), Series 1434 Box 53526, The Ohio Historical Society, Columbus, Ohio.

legislation to attack pollution and "ultimately take a hand in interstate streams."[385] Others, however, rejected this idea and sought for continued cooperation between industries and all the states in the Ohio River Valley.[386]

During the early 1930s and the creation of the New Deal, centralization through the federal government seemed to be the answer for many complex issues in the United States. It is logical that the federal government's hand in finding a solution to Ohio River pollution appeared to be a feasible and effective answer. However, Ohio's past experience revealed that the federal government alone could not get states involved in pollution abatement. A successful resolution would have to mediate between both proposals.

Cincinnati Chamber of Commerce's Regional, Interstate Solution

In 1934, the Cincinnati Chamber of Commerce gathered to discuss its annual local "Clean-Up and Beautify Week." Traditionally, the committee brainstormed projects to "beautify" the city, such as picking up trash, creating gardens, and painting homes in strategic areas. However, when the chairman wrapped up the meeting and asked if there was anything left to be addressed in the city, one man responded with a suggestion of much greater scope and gravity than those typically raised at such routine meetings. As it was one of the city's greatest

[385] The states of Pennsylvania, Colorado, Kansas, Oklahoma, and South Carolina, for example; Iowa is the state quoted. (Ohio Department of Health, "An Analysis of Replies from State Sanitary Engineers on Oil Pollution" American Engineering Council, February 6, 1931, Ohio River Board of Engineers Correspondence, Department of Health Central Files 1936-1965 (Water Resources), Series 1434 Box 53526, The Ohio Historical Society, Columbus, Ohio Reports, Etc. 1929- 1931, Dept. of Health Central Files, 1936- 1965 (Water Resources)).
[386] A few of these states are Kentucky, Indiana, Wisconsin and Texas; Ohio Department of Health, "An Analysis of Replies from State Sanitary Engineers on Oil Pollution" American Engineering Council, February 6, 1931, Ohio River Board of Engineers Correspondence, Department of Health Central Files 1936-1965 (Water Resources), Series 1434 Box 53526, The Ohio Historical Society, Columbus, Ohio Reports, Etc. 1929- 1931, Dept. of Health Central Files, 1936- 1965 (Water Resources).

assets, this man, Hudson R. Biery, recommended that the chamber address the increasingly polluted Ohio River.[387] Biery had no prior professional experience with water pollution and was simply the director of public relations for the Cincinnati Street Railway Company and concerned resident of Terrace Park. An outsider to the public health and engineering groups that typically handled the water supply and disposal of wastes along the river, Biery still observed that the river was becoming increasingly polluted and, despite the city dumping millions of dollars into the situation, public health was at stake. Biery wanted to start a campaign for regional co-operation in pollution control that would alleviate some of the problems faced by Cincinnati, since "citizens of Cincinnati [didn't] want to be reminded every time asparagus is served for supper in Pittsburgh or some other upstream community."[388] He believed, "the time is at hand for someone to provide a rallying point for control of water pollution in our valley."[389] What better way to "clean up and beautify" the city than to begin addressing the problems of its water?

His suggestion was timely, even beyond the impeding local conditions in Cincinnati that contributed to a sense of urgency. Historian Martin Melosi claims, "from the fiscal perspective, the economic disorder of the late 1920s and 1930s changed the nature of city-federal relations and transformed what had been local service delivery into systems increasingly influenced by regional and national interests."[390] This movement away from a city-focused pollution solutions

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[387] Hudson Biery was born in Scottsburg, Indiana in 1888. By the time of his death, he would earn the nickname "Old Man River" due to his consistent commitment to river sanitation efforts. ["Hudson Biery Dies at 78; Ohio River Cleanup Pioneer," *Cincinnati Enquirer*, July 6 1967; "Cleaner River Advocate Dies," *Chillicothe Gazette* (Chillicothe, Ohio), July 6 1967.]
[388] As quoted by Edward Cleary; Cleary, 28.
[389] *Ibid*.
[390] Martin Melosi, *The Sanitary City: Environmental Services in Urban America from Colonial Times to the Present, Abridged*. (Pittsburgh: University of Pittsburgh Press, 2008), 6.

towards regional and national solutions fell well in-line with the solutions for commerce and flooding.

By 1930, mostly due to the Rivers and Harbors acts of 1925 and 1927, water programs changed from single-project approaches to multiple-purpose projects focused on optimum use of the *entire* river basins.[391] In 1933, President Roosevelt created the National Planning Board (later, National Resources Board), as a piece of his New Deal program, which encouraged state-established regional agencies to assume leadership in addressing local, state and federal welfare.[392] The federal government became increasingly vested in public health and pollution abatement; by 1936, 8,000 communities in the United Sates repaired and expanded their sewage and waste systems with Works Project Administration assistance, amounting to nearly $1.2 billion in aid.[393] However, several water pollution control bills failed in Congress during this period. The most significant failure was the "Barkley bill," introduced by Senator Alben Barkley of Kentucky, which provided a framework for future legislation.[394] This appeared to be a significant turning point in strategic method of dealing with problems of water pollution that affected entire regions.

In 1934, the Cincinnati Chamber of Commerce established a subcommittee, the Stream Pollution Committee, under the leadership of Hudson Biery.[395] Biery had a new vision for

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[391] Ellis Armstrong, Michael C. Robinson, and Suellen M. Hoy, eds., *History of Public Works in the United States, 1776-1976* (Kansas City: American Public Works Association, 1976), 32.
[392] This interstate compact was a mechanism provided for by Article I, Section 10, Clause 3. It was effectively employed by American colonial governments, mostly for boundary adjustments but was slowly used less and less over the years. (Cleary, 4); Cleary, 6.
[393] Armstrong, 418.
[394] While the creation of the bill took several years, it was not finalized and introduced submitted to Congress until 1936.
[395] Michael Neuman and Sheri Smith, "City Planning and Infrastructure: Once and Future Partners," *Journal of Planning History* 9 (2010): 28; Pollution of Navigable Waters: Hearings Before the Committee on Rivers and Harbors, House of Representatives, Seventy-Ninth

pollution abatement in the Ohio Valley region and sought to create a forum for regional co-operation in pollution control to alleviate the problems faced by Cincinnati and other cities along the river.[396] Rather than emphasizing the abilities of the federal government to subside pollution, Biery's proposed organization's members worked together in creating fair and uniform standards, designing and supporting the passage of legislation, and combining the police powers of the states to address the problems.

The Cincinnati Chamber of Commerce's Stream Pollution Committee brought together forty civic and technical leaders from a variety of backgrounds: sanitary engineers, industrial leaders, civic association representatives, Department of Health officials, construction engineers, bank officials, President of Real Estate Board, and life insurance executives.[397] The subcommittee created three main project groups under the assignments of legislation, research and planning, and federal emergency and relief activities to address different aspects of the Ohio River pollution problem.[398] Nevertheless, all were united under the belief that "the streams of the Ohio Valley were not intended to serve as sewers and that they should be restored to the proper use in the fields of Public Health, Conservation, Commerce and Recreation."[399]

Congress, First Session on H.R. 519, H. R. 587, and H.R. 4070, Bills for the Control of Water Pollution, November 13-14, 1945 (1945) (statement by Hudson Biery).

[396] Cleary, 28.

[397] "Proceedings of a Meeting: December 7th, 1935 in Cincinnati, Ohio," meeting called by Mr. Alfred Bettman, District Chairman of the National Resources Committee, Folder S. 1.14.22 "1936 Stream Pollution Commission" folder, Alfred Bettman Papers, U.C. Archives and Rare Books, Cincinnati, Ohio.

[398] *Ibid*; Cleary, 28-31.

[399] *Ibid*; Cincinnati Chamber of Commerce Committee on Stream Pollution, "Suggestion #5 Resolution" proposed by Col. Waite, September 10, 1935, Folder S. 1.14.22 "Committee on Stream Pollution, Alfred Bettman Papers, University of Cincinnati Archives and Rare Books Library (UCARB), Cincinnati, Ohio.

In the *Engineering News-Record* in 1935, Mr. Streeter asserted, "the principal obstacles now standing in the way of an intelligent and comprehensive program of river sanitation in this drainage area [referring to the Ohio River Basin] appears to be legal and administrative, as the necessary engineering data are fairly complete and well established."[400] Cincinnati ran into problems because no enforcement by the federal government existed for municipalities and industries to update their treatment systems. Being towards the middle of the river's flow, Cincinnati dealt with not only its waste but also that of West Virginia and Pennsylvania. If industries and cities spent the considerable amount of money required to create and update treatment facilities, in a highly competitive environment, they feared that it would put them behind others, who did not feel it was their obligation to treat waste before sending it down the river. Without equal pressure on all industries and municipalities to keep high standards, there was little motivation for cities to spend funds on treatment when it could be used for more popular endeavors. As an article in the Cincinnati Post asked, "if one city did it, what good would it do if the town upstream was using the river to get rid of its sewer?"[401]

By June 1935, the Chamber of Commerce president and editor of the *Cincinnati Enquirer* who was interested in the pollution of streams, William F. Wiley, successfully convinced leaders in legal, governmental, sanitation, and industrial affairs to join the Stream Pollution Committee. The Committee consisted of big names such as Robert A. Taft (a future senator), Myers Y. Cooper (former governor), Walter Schmidt (president of National Association of Real Estate Boards) and Alexander Thomson (president of the Ohio Chamber of Commerce and chairman on the board of the Champion Paper and Fiber Company). Unlike the other groups in the Ohio

[400] H.W. Streeter, "The Ohio River: Its Future as a Water Supply Source," *Engineering News-Record*, 114 (1935), 612.
[401] "Two Droughts Forced Water Compact," *Cincinnati Post*, June 28, 1948, 17.

Valley concerned with pollution control,[402] whose approaches were usually localized or parochial, Biery's committee sought to attack the wider issue on a regional scale, as done for phenol wastes, with a three-part program of action on local, state and national levels.[403]

On the local level, the Stream Pollution Committee encouraged public support for city bonds and municipalities to seek federal aid for the construction and maintenance of sewage treatment facilities. At this time, grant-in-aids were offered for public works projects, and this was a popular avenue to secure such funds. For Cincinnati, this meant arousing action from the city and its twenty-four adjacent communities in Hamilton County by publishing reports, such as that of the Cincinnatus Association, which documented the poor conditions and the potential risks of stream pollution to public health, and articles in newspapers. A variety of river-interaction activities were important as well. The committee encouraged boating clubs to provide "sewer tours" that took the public to sites that spewed untreated sewage directly into the river. At the state level, the committee's mission was to campaign for an interstate compact among the states in the Ohio River Basin, which granted the power to punish violators. On the federal front, the group sought to introduce legislation that would facilitate this basin-based steam pollution control, such as the Barkley- Vinson bill that was introduced in 1937 to the Rivers and Harbors Committee of Congress.[404] All three fronts were viewed as equally critical to gain widespread support for drastic pollution relief programs and legislation.

These efforts and concerns were very much in line with the movements in Washington D.C. *Drainage Basin Problems,* a study prepared for President Franklin Roosevelt, noted, "Some

[402] Health authorities, sanitary engineers, conservation organizations such as the Izaak Walton League, and boating enthusiasts.
[403] Cleary, 29-31.
[404] Cleary, 28-31.

cities are practically drinking their own and their neighbor's sewage." While thinking more holistically about the nation's rivers, the report could not help but also concern itself with the runoff from breweries, mills, tanneries, mines and sewage plants.[405]

Creation of the Ohio River Valley Sanitation Compact and Commission

Creating a compact and forming an organization that appealed to and satisfied all states within the valley proved to be a complicated and difficult task for the Cincinnati Chamber of Commerce. How would a single agreement and commission be effective and assure all states and interested parties, from industry to specialized recreational groups, receive fair representation? [406] Also, to what extent should or could the federal government be involved? How would the commission implement its decisions? While these were the big questions for Biery and the Chamber's Stream Pollution Committee (generally referring to itself as the Ohio River Valley Sanitation Commission by this point), other questions would arise over the details, from the language of the compact to what standards, if any, should be specified within the agreement.

Local interest groups, individual municipalities, states, and industries had very different positions regarding how the pollution in the Ohio River could and should be curtailed. In general, while seeking the backing of the federal government, the states wanted to remain sovereign in pollution control measures. Industry largely agreed with states, but usually rejected the idea of an interstate agency, based on the belief that their individual state would have industry's best interests in mind. Conservation groups like the Izaak Walton League, on the other hand, believed that federal control was the only solution to truly tackle the problem of pollution

[405] Welky, 52; National Resources Committee, Drainage Basin Problems and Programs (Washington, D.C.: Government Printing Office, 1937), 1, 3, 4-5.
[406]Cleary, vi.

in and along the Ohio River.[407] All of these various points of view contributed it to over a decade of efforts before eight states in the valley signed a finalized compact, the Ohio River Valley Sanitation Compact, in 1948. Hudson Biery managed to successfully refuel a fire against water pollution in the Ohio River Basin and across the nation that was initiated as early as 1908, but the Cincinnati movement had a very different vision and method than those that preceded it.

Biery managed to obtain the best available legal talent in the city to aid in the drafting of an interstate agreement and complementing legislation. The legislation subcommittee, headed by lawyer Robert A. Taft, quickly got to work in 1935, following the advice of the Roosevelt's new National Resources Board (NRB). Director of the NRB, Charles W. Eliot, encouraged the Chamber of Commerce committee to go ahead and draft an interstate compact, possibly informed by the one underway by New York, New Jersey, and Connecticut for pollution control in New York Harbor. Informed by their exhaustive study of existing laws and interstate agreements, the Chamber of Commerce drafted multiple bills with the purpose of curbing pollution of navigable waters. The Chamber decided to these drafts with various governmental departments, such as health departments, engineers, and planning groups, and requested their feedback.[408] By 1936, the U.S. Congress gave the states permission to enter into such a compact proposed by the Cincinnati Chamber of Commerce. Within a few months, Ohio's Governor, Martin L. Davey, began to request governors of other states in the region to get involved and join the committee to finalize an interstate compact.[409]

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[407] Cleary, 31.
[408] "Proceedings of a Meeting: December 7th, 1935 in Cincinnati, Ohio," meeting called by Mr. Alfred Bettman, District Chairman of the National Resources Committee, "1936 Stream Pollution Commission" folder, Alfred Bettman Papers, U.C. Archives and Rare Books, Cincinnati, Ohio.
[409] "Two Droughts Forced Water Compact," *Cincinnati Post*, June 28, 1948, 17.

The Ohio River sanitation group, centered in Cincinnati, envisioned an interstate agreement based on widespread *regional* concerns on an unprecedented scale. No prior interstate compact in the United States aspired to bring eight or more states together for unified self-regulation. Nevertheless, the Chamber of Commerce could not ignore similar successful interstate agreements involving the shared resource of waterways. The Chamber analyzed a multitude of interstate agreements in the creation of the "Ohio River Valley Sanitation Compact," such as the proposed agreement between New York, New Jersey, and Pennsylvania over the Delaware River.[410] However, the final draft resembled the 1935 agreement between New York, New Jersey, and Connecticut concerning the lower portion of the Hudson River more than any other; it liberally employed phrases throughout the written agreement.[411] The growth of regional planning and actions, taking waterways into account, gained legitimacy in the 1930s and 1940s in other portions of the United States. The Tennessee Valley Authority, for instance, complimented this idea that planning and agreements should be placed within a regional framework.[412]

Both Hudson River and Ohio Valley agreements focused on the "increasingly serious pollution" that constituted a "grave menace to the health, welfare, and recreational facilities of the people living in such basin [or area, in the case of the Hudson River agreement] and [was]

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[410] "Confidential Memorandum Re: First Formal Meeting of the Ohio River Valley Water Sanitation Commission, January 20, 1938," from F.H. Waring to Governor Martin L. Davey, Department of Health Central Files 1936- 1965 (Water Resources), Series 1434, Box 53526, Folder: 1936 Stream Pollution Commission, The Ohio Historical Society, Columbus Ohio.
[411] "Minutes of Meeting Held at Neil House, Columbus, November 22, 1937, 2:00 PM" Presiding: Mr. W. F. Wiley, Chairman, Department of Health Central Files 1936- 1965 (Water Resources), Series 1434, Box 53526, Folder: 1936 Stream Pollution Commission, The Ohio Historical Society, Columbus Ohio.
[412] Matthew L. Downs, *Transforming the South: Fedearl Development in the Tennessee Valley, 1915-1960* (Baton Route: Louisiana State University Press, 2014).

occasioning great economic loss." In addition, each attributed the pollution issue to the rapid increase in population, yet only the Ohio River agreement mentioned the growth of industrial activity as a source. The Ohio Valley and Hudson River agreements also required signatory states to pledge "faithful cooperation in the control of future pollution" and to "enact adequate legislation." Bathing and recreation were important concerns in each agreement. However, the Ohio Valley agreement significantly differed in that it was more open ended and vague concerning the specific aspects of the environment it attempted to protect and minimum standards.

The most significant difference between the treaties existed in the particulars regarding the general environment. The Hudson River treaty was more detailed than the proposed Ohio Valley Sanitation Compact, as it referenced the "major fish life, shell fish, and marine life" and the prevention of "oil, grease or solids from being carried on the surface of the water."[413] This difference caused much debate among the committee members.[414] However, drafters believed it was more important to get the compact in place, as more ambiguous requirements may create more support in upstream states like Pennsylvania, and worry about these details at a later date.[415] In addition, this broad agreement provided flexibility, which possibly averted the problems of deeply rooted and outdated minimum standards in the future.

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[413] Committee on Stream Pollution, Cincinnati Chamber of Commerce, Document No. 15, Draft No. 3, "Ohio Valley Water Treaty," February 28, 1936, Department of Health Central Files 1936- 1965 (Water Resources), Series 1434, Box 53526, Folder: 1936 Stream Pollution Commission, The Ohio Historical Society, Columbus Ohio.
[414] Letter from C.A. Holmquist, Director of the Division of Sanitation, to Mr. F. H. Waring, Chief Engineer, Division of Sanitary Engineering of Ohio Dept. of Health, November 30, 1936, Department of Health Central Files, 1936-1965 (Water Resources), Series 1434, Box 53526, Folder: Ohio River Valley Water Sanitation Compact Correspondence- 1936, The Ohio Historical Society, Columbus Ohio.
[415] Letters from W. L. Stevenson, Chief Engineer of Pennsylvania's Dept. of Health, to Mr. Waring, December 2, 1936 and December 14, 1936, Department of Central Health Files, 1936-

With a fairly development agreement draft, Hudson Biery reached out to find allies in his crusade against stream pollution. He joined his efforts with those of the Ohio Valley district chairman of the National Water Resources Committee, a subcommittee of the NRB. In 1935, the chairman, Alfred Bettman, brought together representatives from the district, which included Ohio, West Virginia, Kentucky, Indiana, and Pennsylvania, who showed interest in the water pollution issue to discuss the potential creation of a Regional Planning Authority that addressed problems regional in nature. In his opening statement, Bettman explained why he asked this group to meet:

> River Pollution is the most pressing problem of the Ohio Valley. Much has been done on it. It furnished the motive power out of which this meeting has grown, but that is not to be construed as the ultimate objective… We know that we have different political areas- that the nation has its particular sphere of activities and the state its particular sphere. But, our problem could not be solved solely by state or by national actions because the geographical features involved have furnished us units which do not correspond with either state or national units. We call these units 'regions.' One thing before us, challenging our intelligence as a nation, is how to arrange, within the constitutional frame-work of that nation and of the state, for regional activities. I hope we may create out of the activity resulting from this meeting one possible answer to that.

While the Tennessee Valley Authority offered one answer to regional planning, that of handing all power and authority over to the Federal government, Bettman believed states could tackle issues together, without relinquishing power to the federal government.[416] His view of wider comprehensive planning fell right in line with Biery's mission. Biery used Bettman's group, and its subcommittee on stream pollution, as a means to disseminate knowledge concerning the Cincinnati Chamber of Commerce's accomplishments and plans, in hopes of also additional

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1965 (Water Resources), Series 1434, Box 53526, Folder: Ohio River Valley Water Sanitation Compact Correspondence- 1936, The Ohio Historical Society, Columbus Ohio..

[416] Proceedings of a Meeting: December 7th, 1935 in Cincinnati, Ohio," meeting called by Mr. Alfred Bettman, District Chairman of the National Resources Committee, "1936 Stream Pollution Commission" folder, Alfred Bettman Papers, U.C. Archives and Rare Books, Cincinnati, Ohio.

gaining support. Although it seemed that interest was mounting in the interstate agreement, it would not be an easy journey towards the signing and implementation of the Ohio River Valley Sanitation Compact.

Although Congress gave states permission to enter into an interstate compact in 1936 and approved the resulting document in 1940, it took until 1948 for a finalized compact to be signed by eight states.[417] Most of the downstream states (Ohio, Kentucky, and Indiana), who little to lose, endorsed the compact by 1940. States upstream, specifically Pennsylvania, had a more difficult time approving the interstate compact. Even the Pennsylvania State Department of Public Health rejected the compact, claiming, "there is no doubt that a burden will fall upon Pennsylvania and the Pittsburgh area for the benefit of the downstream cities."[418] This resulted in Ohio and West Virginia establishing the condition that neither state would allow the agreement to go into effect in their states until Pennsylvania accepted it, "inasmuch as little can be done effectively by the two states without Pennsylvania's cooperation."[419] Later, West Virginia placed another provision on the compact, requiring that Virginia also enter the agreement. It would not be until 1940 that the stage would be set in Virginia to introduce the compact to its legislature.[420]

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[417] Progress in Water Quality: An Evaluation of the National Investment in Municipal Wastewater Treatment," "1949 Jan-June Correspondence" folder, Department of Health Central Files, The Ohio Historical Society, Columbus, OH.

[418] "Report of the Interstate Conference on the Ohio River Sanitation Compact," Called by the Pennsylvania Commission on Interstate Cooperation, The Council of State Governments, Held at Hotel William Penn, Pittsburgh, PA, October 17, 1939, "1936 Stream Pollution Commission" folder, Alfred Bettman Papers, U.C. Archives and Rare Books, Cincinnati, Ohio.

[419] *Ibid*.

[420] Letter from F. W. Waring to Mr. Klassen, Technical Secretary of Illinois State Sanitary Water Board, January 12, 1940, Folder: Ohio River Valley Sanitation Compact, Correspondence 1940, Box: Department of Health, Central Files 1936-1965, The Ohio Historical Society, Columbus, Ohio.

Another obstacle was recreational groups; the Izaak Walton League and other sportsmen did not endorse the interstate agreement proposed by Biery and the Cincinnati Chamber of Commerce, asserting that the agreement was biased towards business.[421] Understanding the ability of the Izaak Walton League to sway public opinion, Waring of the Ohio Health Department and Biery attempted to ensure they did not provide the organization with ammunition to attack Cincinnati, the Barkley bill developments, and the interstate compact.[422]

Cincinnati did not let these obstacles for Ohio River Valley Sanitation Compact delay waste disposal reform on the local front. Rather, the city spearheading the Ohio River pollution crusade believed it needed to serve as a model river city. The Stream Pollution Committee took on a timely campaign one year after the city was reminded of the power of the river with the unparalleled 1937 flood.[423] In 1938, a one-million-dollar bond issue for sewage treatment was introduced for voting in November. The committee campaigned for the bond under the slogan, "Let's take the dead hoses out of the water," based on the calculation that the amount of sewage from Cincinnati was equal to one dead hose floating past the city every two minutes.[424] While it was understood these new treatment facilities only took care of a small portion of the river pollution problem, the committee believed local action would stimulate regional co-operation. The day following the passage of the bond, November 9, 1938, an article in the *Cincinnati Times*

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421 Bill Wolf, "Running Sores on Our Land," *Sports Afield,* January 1949, 76.
422 Letter from F. H. Waring to Mr. Hudson Biery, January 12, 1940, "Ohio River Valley Water Sanitation Compact, Correspondence 1940" Folder, Box: Department of Health, Central Files 1936- 1965, The Ohio Historical Society, Columbus, Ohio.
423 David Welky, *The Thousand-Year Flood: The Ohio-Mississippi Disaster of 1937* (Chicago: The University of Chicago Press, 2011).
424 "River Pollution Set Forth In Terms of Dead Horses," *The Cincinnati Enquirer*, October 21, 1938, 8.

and Star stated, "Cincinnati now can show the other states that this city means business and calls upon them to do their part."[425]

Despite the delay on the interstate compact, cities upstream continued to improve legislation that would give the state authority to protect waterways. Relatively small floods further brought awareness to the pollution issues; in 1935-1937, heavy floods washed filth from "disease-breeding cesspools" into the river and illness spread through the valley.[426] In 1937, Pennsylvania Governor H. Earle signed the Clean Streams Act into law. This new legislation focused on industrial waste discharges for not just human consumption but to protect animal and aquatic life as well.[427]

In 1940, consistent with his other public education attempts, Hudson Biery continued to recognize the power of additional citizen support. Although newspaper writers were invited to every meeting to increase public support for the commission and the sewage treatment bond was successful, Biery stepped up his program of public education by participating in an interview with WLW Radio.[428] In the interview, he left out none of the gruesome details concerning the Ohio River:

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[425] Cleary, 37.
[426] Inter-League Survey. *The Ohio River Basin* (Washington D.C.: League of Women Voters Education Fund), 28. [Maurice A. Shapiro Environmental Health Collection, 1919-2001. Folder: 1218-Ohio River, 1951- 1964. University of Pittsburgh Archives.]
[427] The law stated it was to "preserve and improve the purity of the waters of Commonwealth for the protection of public health, animal and aquatic life.";Pennsylvania Department of Environmental Resources. "75 Years of Clean Streams Progress: Highlights of the Commonwealth of Pennsylvania Clean Streams Program, 1905 to 1980." September 1980. Gail Rockwood Papers, 1970-2000. University of Pittsburgh archives.
[428] "Confident Memorandum Re Interstate Treaty On Stream Pollution Prevention, Columbus, Ohio, November 23, 1936," Letter from F. H. Waring to Governor L. Davey, "1936 Stream Pollution Commission" folder, Alfred Bettman Papers, U.C. Archives and Rare Books, Cincinnati, Ohio; "WLW Radio Interview on Stream Pollution, 10:30 AM February 30, 1940, Ohio Federated Garden Club Program, Cincinnati, Ohio," Folder S.1.14.29 "Committee on

> Into this pool the sewer of Cincinnati and other cities on the Ohio side of the river dump about 100,000,000 gallons of raw sewage every twenty-four hours… Much of this sewage is liquid but engineers estimate it includes 450 tons of solid material, principally human excrement, and all the other forms of waste that people dump into sewers. Someone has suggested that this 450 tons of solid material would be equal to dropping a dead horse into the Ohio River every two minutes all day and all night year in, year out.[429]

When asked how much longer this water can be this severely polluted and continued to be used for consumption, Biery informed the interviewer that "engineers do not know how much longer it will be possible to keep the water safe… In the last two years we have had periods of a month at a time when the water contained more than five times the safe limit." Although Biery made this effort to get the word out about what was being done to combat stream pollution and encourage individuals to support the compact and the Barkley bill going through Congress, this interview did not have the effect he wanted it to; Biery's interview was "deleted considerably by the censor of WLW, who fear[ed] a wave of public hysteria if all the harrowing details were broadcast."[430]

In the 1940s, action on the regional front concerning the Ohio River Valley Sanitation Compact stagnated. In the years of 1939 and 1940, the states of Indiana, West Virginia, Ohio, New York, Illinois, and Kentucky adopted the compact.[431] However, without Pennsylvania's

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Stream Pollution: Report of Subcommittee Meeting, Sept 26, 1938; WLW Interview," Alfred Bettman Papers, U.C. Archives and Rare Books, Cincinnati, Ohio.

[429] "WLW Radio Interview on Stream Pollution, 10:30 AM February 30, 1940, Ohio Federated Garden Club Program, Cincinnati, Ohio," Folder S.1.14.29 "Committee on Stream Pollution: Report of Subcommittee Meeting, Sept 26, 1938; WLW Interview," Alfred Bettman Papers, U.C. Archives and Rare Books, Cincinnati, Ohio.

[430] "WLW Radio Interview on Stream Pollution, 10:30 AM February 30, 1940, Ohio Federated Garden Club Program, Cincinnati, Ohio," Folder S.1.14.29 "Committee on Stream Pollution: Report of Subcommittee Meeting, Sept 26, 1938; WLW Interview," Alfred Bettman Papers, U.C. Archives and Rare Books, Cincinnati, Ohio.

[431] F. H. Waring, "Ohio River Valley Water Sanitation Compact," *Civil Engineering* 15, No. 5 (1946), 195-6.

signature, the states were not able to fully implement the compact, due to provisions put into place by the Ohio and West Virginia legislatures.[432] A 1940 Pennsylvania report entitled "A Digest of Industrial Waste Treatment in Pennsylvania" widely circulated in the United States, raising widespread support for industrial waste management. Another study in 1942 estimated that in a single year ground and surface water, traveling through the coal mines, picked up and carried over 2.5 million tons of acid, mainly sulphuric, into the river. Concern for the river grew.[433] By 1944, the Sanitary Water Board removed the exemption of coal silt from pollution control measures, and the following year, the state approved a series of acts preparing to enter the interstate compact.[434] The Second World War can be greatly blamed for the delay in the early years of the decade, but the late and post war public works construction programs of sewage treatment facilities renewed interested in Pennsylvania's legislature to join the interstate compact.[435]

In 1948, the same year as the passage of the Federal Water Pollution Control Act that supported the Ohio River agreement, Pennsylvania's legislature finally agreed to join the compact. On Wednesday, June 22, 1948, the governors of Ohio, Indiana, Kentucky, West Virginia, Virginia, New York, Illinois, and Pennsylvania gathered in Cincinnati for a ceremonial

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[432] "Letter from F. W. Waring to Mr. William A. Mills, Director of Organization Relations, Ohio Chamber of Commerce," Folder: "Ohio River Valley Water Sanitation Compact, Correspondence, 1944, Box: Department of Health Central Files 1936- 1965, The Ohio Historical Society, Columbus, Ohio.

[433] Inter-League Survey. *The Ohio River Basin* (Washington D.C.: League of Women Voters Education Fund), 28. [Maurice A. Shapiro Environmental Health Collection, 1919-2001. Folder: 1218-Ohio River, 1951- 1964. University of Pittsburgh Archives.]

[434] Pennsylvania Department of Environmental Resources. "75 Years of Clean Streams Progress: Highlights of the Commonwealth of Pennsylvania Clean Streams Program, 1905 to 1980." September 1980. Gail Rockwood Papers, 1970-2000. University of Pittsburgh archives.

[435] "War Cited in Ohio's Failure to Enforce Pollution Control." *Cincinnati Enquirer*, Nov 15, 1945; F. H. Waring, "Ohio River Valley Water Sanitation Compact," *Civil Engineering* 15, No. 5 (1946), 195-6.

signing of the Ohio River Valley Sanitation Commission.[436] The Commission was praised as a model by many for several decades, even the American Society of Civil Engineers referred to the agreement in 1963 as "the most effective large-scale water pollution program ever undertaken in the Western Hemisphere."[437] Even those who had not fully supported the Ohio River Valley Sanitation Commission from its inception agreed it was a great starting point for addressing the problems the Ohio Valley experienced for at least half of a century prior. A 1949 article in *Sports Afield*, a magazine for fishing enthusiasts, stated, "it is a surprisingly strong compact, and amounts to pooling the police powers of the eight states to enforce the rules of the group. It isn't ideal, but it's more than the Ohio basin ever had before. It's like the new National Pollution Act, an opening wedge against pollution, not a final solution… The Ohio River compact is realistic, making the most of what gain it has secured."[438]

The states' commitment to the interstate compact led to significant reforms within their own state boundaries and improvement in the quality of their shared river. The ORSANCO commissioners agree upon regulations and the participating states must pass the necessary laws that were not previously in place. ORSANCO's earliest efforts focused on controlling the acid mine drainage from abandoned mines. Between 1948 and 1949, Pennsylvania further regulated discharges, from prohibiting cyanides to regulating oil, gas, and acid drainage. By 1956, the power of the commission grew as the federal government became another funding source.[439] The commission was successful with curbing municipal pollution; by 1962, ninety percent of the

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[436] "Two Droughts Forced Water Compact," *Cincinnati Post*, June 28, 1948, 17.
[437] Cleary, 283.
[438] Bill Wolf, "Running Sores on Our Land," *Sports Afield*, January 1949, 76.
[439] Inter-League Survey. *The Ohio River Basin* (Washington D.C.: League of Women Voters Education Fund), 30. [Maurice A. Shapiro Environmental Health Collection, 1919-2001. Folder: 1218-Ohio River, 1951- 1964. University of Pittsburgh Archives.]

Ohio River Basin had sewage treatment facilities, up from just thirty-eight percent in 1948 when the states signed the compact.

By the beginning of the twentieth century, the Ohio River began to lose its economic role in cities such as Cincinnati. However, the river remained an essential asset that required protection in an increasingly industrializing region. The Ohio River the cities once knew was completely transformed due to an increasing focus on predictable river navigation and the booming use of the waterway as the primary industrial and municipal waste disposal for at least eight states. No single city or state could effectively curb pollution or clean up the river on its own. Therefore, solutions to the problem tended to look toward the federal government for support and guidance. These efforts, though, typically only address single sources of pollution, rather than the problem in general, and were chiefly unproductive since states were commonly unequally invested in the problem-solving process.

It was not until 1934 that a successful and thorough resolution arose out of an organization formed by a group of elite businessmen in Cincinnati. The Cincinnati Chamber of Commerce successfully demonstrated to the city's neighbors that its plan for an interstate compact was the answer to the finally begin tackling the entire Ohio Valley region's water pollution problems. In June of 1948, eight states were the first to sign the official Ohio River Valley Sanitation Compact, which combined the states' policing powers and financial resources to deal with the river's pollution amongst the states. The majority of power resided within the states, and the federal government was not heavily involved beyond some technical and financial assistance.

Through intentional efforts to address municipal and industrial pollution of the Ohio River, the valley recognized that the region was tied together by ecology as much as economy. During most of the nineteenth century, the region worked together to lobby federal funds for commercial interests. By the mid-twentieth century, Ohio River Valley became more than a region of industry and nineteenth century urbanization; it was inherently, permanently tied by the geography and ecology. Those in the public health and planning sectors of the twentieth century recognized these connections, which no human could alter.

While the Ohio River Valley Sanitation Commission has undergone a significant development since its official implementation in 1948, it remained an important entity in the remainder of the twentieth century. The commission was responsible for setting wastewater disposal standards, monitoring the river through its world-renowned monitoring system, and conducting research and surveys along the river.[440] If or when there was a spill in the river, the Ohio River Valley Sanitation Commission was one of the first governmental agencies to respond. A citizen group of elite businessmen in the mid-twentieth century managed to devise a governmental organization with lasting impacts for at least seven decades.

[440] "About Us," Ohio River Valley Sanitation Commission, accessed February 12, 2014, http://www.orsanco.org/about.

Conclusion

The story of Ohio River's physical and ecological transformations over the course of two centuries expands historians' knowledge of how modernizing societies' changing needs transformed waterways. Well-used rivers have to please multiple constituents such as the federal government, industrial and commercial interests, and residents. In their negotiation processes, the river was fundamentally transformed in a manner that was always meant to be permanent. Nevertheless, human perceptions and past decisions, including legacy pollution, limited the ability to envision a new river. In the late twentieth century, then, the ultimate question became whether the Ohio River was clean enough. The river increasingly becomes "clean," but who determines what is clean enough in a well-used river? The transformation impacted the river's ecology in a manner unpredictable to humans, which encouraged additional reinventions. The river continued to flow through all of these changes, but the ecology of the Ohio River at the end of the twentieth century hardly resembled that of earlier centuries.

Just as every generation rewrites its history, every generation must redefine their place within the natural world. The Ohio River underwent several phases of re-engineering based on changing views of how a river should function and serve the communities it runs through. In the nineteenth century, the federal government approved and invested in removing pieces of the riparian habitat to aid river navigation, but the Army Corps of the Engineers' interventions in the river grew over the course of the next century. By the mid-twentieth, interests beyond those of navigation and industries dependent upon it, such as coal, started lobbying for the federal government to also invest in flood control and pollution abatement, which benefited residents more so than commerce and industry.

In August 1983, the National Bass Tournament held its annual Bassmaster classic, the world's biggest fishing tournament, for the first time "on the beautiful and *clean* Ohio River."[441] *New York Times* reporter James Baron noted later that this event "was a happy milestone in the cleanup" of the river.[442] His 1985 *New York Times* article documented the alarming realization in the 1960s that the river's fish population was unhealthy and depleted. He described a subsequent push to remediate the situation, which increased the proportion of commercial fish (catfish, buffalo fish, and freshwater drum fish) in the river from 21 to 33 percent between 1968 and 1981.[443] While Baron noted the progress in the river's condition leading up to the 1980s, he noted that much work still needed to be done, but this task was not easy.

Leo Weaver, the executive director of the Ohio Valley Water Sanitation Commission cited in the 1985 *New York Times* article, claimed, "Any time you have a well-used river, you're going to have industrial spills and municipal problems."[444] Cities and towns along the river used it in many ways, and industrial development along the river used it as a source of energy and pollution dilution. However, legacy pollution is not always easy to find. With exploitation of its energy, people in the Ohio Valley accepted the river as a symbol of progress and triumph to humans and accepted a polluted and diminished river. Over the previous decades, the Ohio River Valley Sanitation Commission (ORSANCO), a multi-state, regional organization developed in response to the degradation of the river, implemented a very sophisticated alert system for

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[441] Patricia Meder, ed. "Calendar August 1983," *Cincinnati Magazine*. August 1983. *Google Books*.
[442] James Barron. "The New, Improved Ohio River." *The New York Times*. January 27, 1985. http://www.nytimes.com/1985/01/27/weekinreview/the-new-improved-ohio-river.html
[443] Barron.
[444] Barron.

pollution along the entire course of the 981-mile long river.[445] However, this was simply a monitoring system and, despite many efforts to address pollution, politics limited the ability of the environmental organizations to go beyond this, to eliminating pollution.

By the mid-1980s, some Ohio Valley residents questioned the assumption that the Ohio River should be a working, industrial, "well-used" body of water, envisioning a new river for recreation and pleasure. This was a moment in which ecologically conscious humans sought to fundamentally redefine the river's role within society, but it was certainly not the first effort to redefine the river. Over the previous centuries, humans continuously defined and refined the Ohio River in ways that had on the river's ecology, encouraging more reinvention of the waterway. The 1980s, the decade following the growth of the environmental movement and the growth of state and national "Scenic Rivers" programs, were another moment in which the Ohio River had to meet another vision.

Since the early settlement of the Ohio Valley, the Ohio River underwent an ecological transformation that was very much tied to humans' expectations of the river itself. Analyzing these changing expectations is just as key as understanding the extent of physical changes if one is to comprehend the river and its evolving connection to society. In the early twenty-first century, the Ohio River earned the title for most industrially polluted body of water in the United States, based on the amount of industrial chemicals dumped into the river.[446] Yet, in 2019, the Ohio River Valley Sanitation Commission decided its long role as a regulatory body had come to

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[445] Jerry G. Schulte, "Development of a Water Quality Monitoring and Early Warning Detection System on the Allegheny and Monongahela Rivers in Pennsylvania." Ohio River Valley Water Sanitation Commission. February 20, 2016. http://archive.epa.gov

[446] Jennifer Schack, "Report: Ohio River most polluted body of water in U.S. for seventh year in row." WLWT. February 24, 2015. http://www.wlwt.com/article/report-ohio-river-most-polluted-body-of-water-in-u-s-for-7th-year-in-row/3551807

an end. It removed itself from creating and enforcing regulations based on the belief that the Ohio River was ecologically restored, the national Environmental Protection Agency had high standards and adequately enforced those standards, and the regional industries were deeply invested in a healthy riparian environment that they would not pollute it again.

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