

CEMENTING AMERICA:  
THE MATERIAL THAT BOUND ARTIFICIAL STONE AND SHAPED EVERYDAY LIFE IN THE  
UNITED STATES

by  
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of  
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## DEDICATION

This dissertation is dedicated to the dozens of family members, friends, and teachers who, from my earliest memories, encouraged my curiosity by communicating their interest in what I was learning and by modeling their own modes of inquiry. It is also dedicated to Mindy, without whose support and accompaniment the dissertation would have neither started nor ended, and to Linden and Kira, who joined along the way.

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## TABLE OF CONTENTS

1. INTRODUCTION .....	1
Cement or Concrete—What’s the Difference? .....	2
An Overview of Cementing America .....	12
Chapters of Cementing America.....	12
The Profound Products of Living with Cement.....	16
2. TOWARD A MORE PERFECT UNION: THE CONTINUOUS REFINEMENT OF CEMENT’S COHESION AND WATER RESISTANCE FROM THE CANAL ERA TO THE CONCRETE AGE .....	18
The Imperial Pursuit of Impure Limestones.....	23
Finding Natural Cement in the United States .....	33
Laboratory Cement: Standardization in the United States .....	39
Microscopy: Looking for Cohesion Beyond the Plainly Visible.....	51
Testing and Mixing to Avoid Voids .....	57
The Problem of Pores: Supplementing Cement’s Impermeability .....	63
Cement Knowledge Diaspora .....	70
Conclusion .....	72
3. ENVIRONMENTS OF CONFINEMENT: THE AMERICAN TRANSITION FROM LIME TO CEMENT IN RELATION TO MODERN PRISON CONSTRUCTION .....	75
Mortar Makes the Modern Penitentiary.....	80
Penitentiaries Become Contentious, but Cement Sticks.....	102
Cement: Standard of Prisoner Reform and Modern Hygiene.....	122
Punishment by and Exploration of Ubiquitous Cement .....	130
Conclusion .....	138
4. CEMENT SURFACES IN THE CITY: THE INFLUENCE OF CONCRETE SIDEWALKS ON CIVICS, CULTURE, AND FASHION IN URBANIZING AMERICA.....	142
Walking without Cement: Flagstone Districts and Reliance on Rubber .....	147
Streetcars and the Less-Walking City .....	158
Sewers, Cement, and Civil Engineers.....	164
Artificial Stone Sidewalks .....	168
Characteristics of Concrete Sidewalks .....	188
New Definitions of Walkability .....	191
Concrete Sidewalks Cultures, Part I: Cement Citizenship .....	193
Illegal Bicycling .....	195
Doing Your Part by Shoveling .....	199
Concrete Sidewalk Cultures, Part II: New Footwear Steps onto the Street .....	205

## TABLE OF CONTENTS CONTINUED

Rubber and Canvas: The Tennis Shoe and the Boat Shoe Become Everyday Shoes .....	210
Conclusion .....	213
5. FROM SICKLY CELLARS TO BENEFICENT BASEMENTS: HEALTH, RESPECTABILITY, AND HOUSEWORK IN THE DOMESTIC SUBTERRANEAN OF THE NORTHERN UNITED STATES, 1850-1930.....	216
The Ruinous Underground .....	220
Cement Begins Modernizing the Cellar .....	224
The Beat Against Cellar Dwelling Goes On.....	227
Domestic Utilities and Domestic Help in the Underground.....	232
Achieving Cleanliness Underground.....	237
The Kids Are Alright in the Basement.....	241
Not Quite an Indoor Space: Vestigial Cellar Cultures & Making Messes.....	244
Standardized Concrete and Mainstreamed Basement Living.....	246
Conclusion .....	250
6. SAFE BASEMENTS: FINANCIAL PLANNING, FAMILY RECREATION, FALLOUT PREPAREDNESS, AND REMEDIATION IN AN IDEAL DOMESTIC UNDERGROUND.....	254
The New Deal and the New Ideal Basement.....	258
Early Brushes with the Limits of Cement Barriers.....	269
The State of the Basement at War's End .....	273
Postwar Housing Boom: A Case Study in Skokie, Illinois.....	277
Basements Across Skokie.....	281
Socializing and Recreating in the 1950s Basement.....	282
Mothering in the Midcentury Basement.....	286
Dads Build-out the Basement.....	288
Stuff & Storage in the 1950s Basement.....	292
Surviving in the Basement.....	295
Cracks in the Safe Basement .....	302
Conclusion .....	312
7. CONCLUSION: FUTURE CEMENT SOCIETIES .....	314
REFERENCES CITED.....	325

## LIST OF FIGURES

Figure	Page
1. Figure 1.1. Plan of the 46th layer of interlocking stones in Smeaton’s design of the third lighthouse on the Eddystone Rocks. Published in Smiles, <i>Lives of the Engineers</i> (1861). .....	25
2. Figure 1.2. Stratigraphic column and table of associated mineral compositions, by Frederick Burritt Peck in a report to the Lehigh Portland Cement Company on limestones near New Castle, Pennsylvania. Courtesy of Lehigh University Special Collections. ....	48
3. Figure 1.3. Approximate locations of the thirty Lehigh area cement plants named in a 1906 thesis submitted to Lafayette’s Department of Mining Engineering by students Fred Uhler and Chester Atkinson. Map data ©2025 Google. ....	50
4. Figure 1.4. Uhler and Atkinson’s thesis also included a copy of this map that their advisor, the geologist F.B. Peck, likely produced for the State of Pennsylvania. Comparison with Figure 1.3 reveals how closely the cement plants followed a regional layer of rock now known as the Jacksonburg Formation. Peck calls this “the rock used in the manufacture of Portland and Rosendale cements,” the latter being a common synonym for natural cement, derived from the Hudson Valley location that produced so much of that material into the late 1800s. The three major Lehigh Valley cities are visible, West to East: Allentown; Bethlehem, with Lehigh University in South Bethlehem; and Easton, with Lafayette College. Image courtesy of Special Collections & College Archives of Lafayette College.....	51
5. Figure 1.5. Microscopy photographs from Henri Le Chatelier, <i>Experimental Researches on the Constitution of Hydraulic Mortars</i> , trans. Joseph L. Mack (1905).....	54
6. Figure 1.6. Rendering of a hand-operated cement mixer included in the 1904 thesis of Milton Cory submitted to Lehigh University. Such cubic metal boxes on a shaft had become standard cement mixing equipment.....	60
7. Figure 1.7. Photograph of a construction site in San Francisco, showing a swimming pool being built within the foundation of a future building. The image was advertising the new Medusa brand as a more waterproof cement.....	67
8. Figure 2.1. Walnut Street Jail’s exterior, with its carefully laid masonry and cupola, presaged other new institutions of independent Philadelphia. ....	84

## LIST OF FIGURES CONTINUED

Figure	Page
9. Figure 2.2. From the start, the interior of Walnut Street included a greater number of separated chambers than previous jails. However, the only true cells for individual confinement (labeled “D”) were added later as infill and comprised only a small part of the total floor plan.....	89
10. Figure 2.3. Plan view of Eastern State Penitentiary after infill in the early twentieth century. The most heavily shaded elements, including the exterior wall, gatehouse, and seven radiating cellblocks, were original to the first phase of construction that began in the 1820s. ....	132
11. Figure 2.4. Photograph of a bare, underground concrete punishment cell in the Eastern State Penitentiary space that was known as “Klondike” during the early twentieth century. Collections of the Historical Society of Pennsylvania.....	133
12. Figure 2.5. The greenhouse at Eastern State Penitentiary as it appears today. Photograph by the author. ....	137
13. Figure 3.1. An 1876 side-laced boot as example of “Bygone Fashions in Boots,” in <i>Three Hundred Years of Shoe and Leather Making in Massachusetts</i> , 1930. Viewed at the Massachusetts Historical Society.....	156
14. Figure 3.2. Map of streetcar routes in Portland, Maine, up through the system’s January 1896 electrification. The map is slightly rotated, meaning the dotted line of wharfs at the bottom in fact runs northeast to Fort Allen Park. That waterfront and the bottom of Back Cove here form the long sides of the peninsula that defined Portland’s city limits in this period, with the central Congress Street ascendant as a commercial and cultural corridor. Most of the rest of the map is Deering, the area of streetcar suburban development adjacent Portland proper. Recreated by Edwin B. Robertson and published in <i>Remember the Portland Trolleys</i> (1982).....	161
15. Figure 3.3. Preparation for solid street surfacing on Portland Street (now Park Avenue) between Forest and Deering Avenues, Portland, Maine, 1904. Two carriage lanes, until then gravel and for the moment dirt, were divided by the existing streetcar rails and electrification, which was itself at most eight years old at the time. A smooth sidewalk, likely concrete, is also visible on the edge of Deering Park to the left.....	162

## LIST OF FIGURES CONTINUED

Figure	Page
16. Figure 3.4. Cobblestone street paving with crosswalks of flagstone at Dock Square, Boston, Massachusetts, ca. 1860. This particular arrangement of surfaces had been maintained for at least two decades, and it demonstrates the preferential pavement of crosswalks that would remain common into the concrete sidewalk era. Image courtesy of Historic New England, via Archipedia New England. ....	164
17. Figure 3.5. Sketch of a proposed street widening project on Portland’s eponymous street (now Park Avenue), showing in the background one entrance to Deering Oaks with its many winding walking paths. Published in <i>Annual Report of the Commissioner of Public Works, Portland, Maine, 1895-96</i> . ....	172
18. Figure 3.6. Approximate locations of artificial stone sidewalks laid in Portland, Maine, from the first use of concrete for public walks in 1894 through the 1900 construction season. The points, which represent the street rather than the specific location of a project, are graded from lighter over time, starting with black for 1894. Neighborhoods beyond Oakdale were part of the City of Deering until the 1899 annexation. Created by the author atop map data ©2025 Google.....	176
19. Figure 3.7. Deering’s Woodfords Corner intersection, showing dirty road surfaces and inconsistency of sidewalks and crosswalks. On the left is some evidence of the ongoing construction by which Deering was quickly developing into a modern city landscape. Published in <i>Deering: A City of Homes 1897</i> , and viewed at the Brown Research Library of the Maine Historical Society.....	177
20. Figure 3.8. This section of State Street in Portland, Maine, 1901, included smoothly paved sidewalks, curbstones, cobblestone gutters, and a dirty roadbed. Image published in <i>Souvenir of Portland, Maine</i> , viewed at the Brown Research Library, Maine Historical Society.....	179
21. Figure 3.9. A map view of the same projects in Dillon. Created by the author with ESRI ArcGIS. ....	183
22. Figure 3.10. Chart showing feet of concrete sidewalk projects in Dillon by month, according to who initiated the sidewalk. ....	184
23. Figure 3.11. Detail of the 1905 Olmsted Brothers plan for Eastern Promenade and Fort Allen Park, showing the several pedestrian entrances and their connection to city sidewalks. Maine Historical Society collections. ....	187

## LIST OF FIGURES CONTINUED

Figure	Page
24. Figure 3.12. The improved sidewalks on this block of Portland’s High Street would have appealed to cyclists over the dirt roadbed, especially in inclement weather. From the 1903 <i>Annual Report of the Commissioner of Public Works</i> .....	197
25. Figure 3.13. Comparison of a typical rubber overshoe’s extent of coverage and the much smaller “foot hold” meant as much for traction as it was for protection of the shoe and foot. From issue no. 35 of the <i>Rubber Trade Journal</i> , viewed at the Baker Library of Harvard Business School.....	204
26. Figure 3.14. A review of new products from Hood Rubber underscored how the company set out to stay relevant in waterproof footwear even as the shoe industry pivoted toward modern, sleek styles. Published in <i>The India Rubber World</i> 18 (August 1, 1898) and viewed at the Baker Library of Harvard Business School.....	209
27. Figure 3.15. The Western reference of Hood Rubber’s “Red Rocks” line of casual shoes was complemented by an illustration of the Sioux dancers whose performance the wearer might attend while on vacation. Published in the booklet <i>Net Prices to Retailer of Tennis Shoes Manufactured by Hood Rubber Company, August 1<sup>st</sup>, 1913</i> , and viewed at the Baker Library of Harvard Business School.....	212
28. Figure 4.1. Sketch of a tenement in obvious disrepair. The dark void of a basement is advertised for rent. Illustration originally printed in Riis, <i>How the Other Half Lives</i> , 176.....	228
29. Figure 4.2. A model modern basement complete with table tennis equipment, published as an illustration Ethel Wan-Ressel’s 1929 <i>Better Homes and Gardens</i> article, “The Basement Beautified.”.....	250
30. Figure 5.1. Zip Zeller in his basement workshop. Published with “Small Workshop with Big Ideas” in <i>Better Homes and Gardens</i> (April 1957), and viewed in the Proquest Women’s Magazine Archive.....	256
31. Figure 5.2. A before-and-after set of photographs showing how the concrete basement purchased by Norman Radder was sturdy, sealed, and otherwise well-maintained but had not been realized as the underground living space that fully cemented basements encouraged and protected. Published with “The Basement Steps Out” in <i>Better Homes and Gardens</i> (May 1935), viewed in the Proquest Women’s Magazine Archive.....	261

## LIST OF FIGURES CONTINUED

Figure	Page
32. Figure 5.3. Images from the 1930s demonstrating that basement development became a selling point for Masonite boards: Above, a 1937 advertisement brought up familiar themes of basement living as economical while evoking the fun and satisfaction that could be had underground. At right, an earlier advertisement, from 1930, tied family growth to the construction of extra rooms in spaces that included the basement. ....	262
33. Figure 5.4. A page from the 1936 American Radiator Company publication <i>Castles Underground</i> featuring images of existing conditions and converted floor plans of two basements. Image courtesy of the Chicago History Museum, ICHi-189026. ....	264
34. Figure 5.5. Example diagrams, printed in domestic periodicals and books that encourage homeownership, showing cement and concrete's role in securing a dry basement either during initial construction or as a subsequent fix. The top two images were published with "How Dry I Am" in <i>Better Homes and Gardens</i> (May 1938) and the bottom image was published with "A Story in Your Basement" in <i>Ladies' Home Journal</i> (April 1929), both in the Proquest Women's Magazine Archive. ....	271
35. Figure 5.6. In the 1970s, Section 21 of the Luxembourg Brotherhood of America met in the Wilmette, Illinois, basement of one member. The bar, often supplemented by a sink and sometimes even by the home's second refrigerator or freezer, was a locus of socialization. Image courtesy of the Wilmette Historical Museum. ....	284
36. Figure 5.7. In 1957, the Allegretti family's newly remodeled basement in La Grange, Illinois, exemplified how the television had become central to practices of socializing and entertainment in the electrified, comfortable, cement-encased underground. HB-20511-E, Chicago History Museum, Hedrich-Blessing Collection. ....	286
37. Figure 5.8. These photos taken in December of 1957 and April of 1958 show the Evanston, Illinois, basement of Frank Nahser and his unnamed family members. The images illustrate not only the renovation but also the gendered distinction between the spruced-up laundry area and the new wall for organizing painting and carpentry tools. HB-21051-B and HB-21051-I, Chicago History Museum, Hedrich-Blessing Collection. ....	288

LIST OF FIGURES CONTINUED

Figure	Page
38. Figure 5.9. Wood paneling had been a component of the new basement recreation room ideal since its appearance in domestic magazines circa 1930. But as seen here, the water-sensitive paneling reached a new level in the 1960s. Author's collage of images published with "Step by Step to a Finished Basement" in <i>Better Homes and Gardens</i> (November 1965), in the Proquest Women's Magazine Archive. ....	289
39. Figure 5.10. A demonstration basement fallout shelter prepared by the Office of Civil Defense Mobilization amounted to a second foundation wall of concrete blocks and cement mortar that connected to the existing foundation walls. The image gives a sense of why most American homeowners with a basement decided that the concrete foundation walls they already had would sufficiently protect their families. ....	296

## ABSTRACT

Engineers and material scientists around the world are now developing alternatives to conventional cement and to concrete, the construction medium for which cement is crucial. Their research mostly aims to reduce cement production's significant global carbon footprint. In the face of these imminent transitions, history can account for how cement, a seemingly prosaic material, became so integral to modern life that it must be gradually replaced rather than simply abandoned. This historical study employs new theoretical approaches to reveal a non-living material's participation in cultural developments. It traces cement as a co-creator of specific practices and modes of thinking that emerged in the United States. To better understand the physical properties of conventional cement, the study first follows the transfer of English and European hydraulic cement technologies across the nineteenth century, from the Canal Age into the Concrete Age. It then takes as case studies three key modern technological artifacts of the US built environment: prisons, sidewalks, and home basements. For each artifact, the question is how cement's ability to separate and impede helped create not only shared cultures but also social distinctions.

The research shows that in prisons, cement not only shielded prisoners from uncomfortable and unhealthy wind, precipitation, and disease but also shaped prison reformers' ideas of how a convict might be guided to penitence. In sidewalks, cement was such an effective barrier between feet and mud that it influenced new footwear styles and new laws of street use. In basements, cement made the domestic subterranean first a respectable space for middle-class white homemakers and then an icon of American suburban home life. Widely recognized as a moldable, durable, yet lifeless medium of cultural expression, the three artifact cases make clear that concrete was much more than this: it was a barrier material that fundamentally transformed physical, social, and political spaces. The engineers, architects, and policy experts currently reinventing cement can find in this history several key cultural and political criteria that innovative producers and consumers alike might use to decide which aspects of cement are worth preserving and which should change in the coming years.

## INTRODUCTION

“When one studies technology...one is in fact confronting the very center of American experience.” - Elting Morison, paraphrasing Thomas Hughes in *American Genesis*<sup>1</sup>

Cement and concrete have long been viewed as the epitome of stolid things, so exceedingly plastic and soulless that they can reflect all manner of cultural, economic, and political forces. However, in “Cementing America,” I reveal how the physical nature of cement and concrete also became a force for creativity and historical change. Misguidedly applied as a barrier around prisoners in hopes of facilitating penitence, cement inflicted a sensory punishment that became standard in American penal facilities. Applied as miles upon miles of smooth sidewalks, thoroughly separating feet or wheels from the earth below, cement made possible new footwear styles and new practices of urban mobility. Applied as a material for protecting first food stores then the heating equipment in cellars, cement invited middle-class mothers into the modern basement and later fostered practices of investing in the nuclear family’s future. Repeatedly, ubiquitous cement opened and defined new opportunities for American culture, and the material’s properties helped both to create and sustain new social and cultural dynamics.

This is a history of cement in the United States, its development into a standardized material with known properties, and the influence that cement materials had on everyday American experiences by way of their ubiquitous application, primarily though not exclusively in the form of concrete. By impeding flows of water, gases, sounds, and more, cement separated environments and literally created new spaces with which Americans developed ideas and practices ranging from what shoes they wore to how they recreated in their homes to how they incarcerated their fellow citizens. “Cementing America” chronicles how modern cement became what it is while simultaneously accounting for how this technology shaped American life via sidewalks, basements, and prisons.

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<sup>1</sup> Elting E. Morison, review of Thomas P. Hughes, *American Genesis: A Century of Invention and Technological Enthusiasm 1870–1970*, *Technology and Culture* 32, no. 1 (January 1991), 128.

### Cement or Concrete—What’s the Difference?

Until I began this project, I did not clearly understand that “cement” and “concrete” refer to two different, albeit related, things. Quickly I learned that cement is actually an ingredient in any structure called concrete, though it can also be used on its own for various purposes. The distinction is important, as will become clear. But even now I do not now jump to correct anyone who uses the words interchangeably in, for instance, recounting how a kid skinned their knee. I would like to think I have maintained perspective on what is truly important despite my newfound skill of distinguishing cement from concrete. Moreover, using the words interchangeably is often quite justified.

At the same time, knowing the distinction has engendered a fascination with what is and is not common knowledge to me and to my fellow Americans. For instance, though they are both so ubiquitous, why is it a good bet that vastly more Americans could name the three basic ingredients of pizza than the three basic ingredients of concrete? To take this further, I would also wager more Americans could tie a topic of society and environment to at least one pizza ingredient (perhaps: migrant labor to tomatoes, cows releasing methane to cheese, grain subsidies to wheat) or to pizza in whole (perhaps: diet-related health conditions) than could do the same for cement, sand, and gravel, or the concrete those three ingredients combine to create. While sand and gravel simply give concrete its volume, cement powder—when mixed with water, as flour is for pizza dough—chemically transforms in the process to bind concrete together.

The historical development of sidewalks in US cities, the subject of my third chapter, is likely the reason so much confusion exists between the terms cement and concrete. The trouble began with sidewalks people called concrete, which predated sidewalks containing cement. Like the word cement, concrete once had a broader meaning. Rather than only sand and gravel bound together by cement, concrete once meant any combination of materials that had coalesced and hardened into a new object. In

the 1860s, a sidewalk called concrete tended to be a mass of crushed stone or gravel solidified by tar.<sup>2</sup> An initial use of hydraulic cement in sidewalks during the 1870s was as a sealant atop these older “concrete” walks—a means of keeping the liquid tar from oozing up to the surface, as it was prone to do during hot weather.<sup>3</sup>

Only around 1890 would hydraulic cement become commonly used as the binder for entire sidewalk structures, which were distinguished from the tarry alternatives with the term “artificial stone” if not simply “cement.”<sup>4</sup> Around the same time, use of another sticky petroleum-derived binder called bitumen increased as an alternative to tar. Though bitumen-bound asphalt was also a concrete in the old sense of the word, these new pavements did not always receive the name concrete.<sup>5</sup> Instead, concrete remained associated with tar-bound pavements. As it became more common during the first half of the twentieth century, concrete gradually came to mean cement-bound pavements while asphalt came to mean the black tarry stuff more typically used on roads and parking lots.<sup>6</sup> Small wonder, then, that confusion between concrete and cement persists.

Regardless of etymological confusions, cement became the key ingredient for the ubiquitous concrete. Those who have read any public-facing article on cement and concrete likely have encountered this extraordinary fact: Concrete, by volume, is second only to water on an ordered list of all the things that humans today collectively acquire and use—or consume, so to speak.<sup>7</sup> One’s immediate reaction to

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<sup>2</sup> For examples, see “Items of State News,” *The Portland (ME) Daily Press*, May 23, 1866, 1, CA; “City Affairs,” *The Portland Daily Press*, August 11, 1868, 2, CA.

<sup>3</sup> On what tar-bound concrete sidewalks did in warm temperatures, see Nathan B. Abbott, “Improvement in Composition Pavements and Sidewalks,” US Patent 123,658, issued February 13, 1872.

<sup>4</sup> For an example of “artificial stone,” see Office of Commissioner of Public Works, *Annual Report of the Commissioner of Public Works, City of Portland 1905* (Portland, ME: Marks Printing House, 1906), 42, PWD.

<sup>5</sup> See for example “Westbrook,” *The Portland Daily Press*, March 13, 1894, 2, CA.

<sup>6</sup> Though the last thing these terms needed was more confusion, a use of “tarred concrete” to mean a road surface of cement-bound concrete covered with a layer of bitumen can be found in Office of the Commissioner of Public Works, *Annual Report: Commissioner of Public Works - 1913, City of Portland, Maine*, (Portland, ME: Marks Printing House, 1914), 13, PWD.

<sup>7</sup> See, for example, Lara Williams, “World’s Second-Most Used Material, Concrete, Needs a Makeover,” Bloomberg Opinion, as published in *The Taipei Times*, October 26, 2024, 9.

hearing that fact is likely, as intended, to marvel at how much concrete humanity consumes. Consider, also, that it means people around the planet are tied together by their relationships with cement and concrete more than by anything except the molecules of hydrogen and oxygen by which all life exists. Despite its sheer ubiquity, though, people's relationships with cement are not, and have not been, the same even within a single city or region, let alone globally. Hence the need for this account and analysis of the diverse American relationships with cement.

In recent decades, the immense scale of global concrete consumption is most often mentioned in reports whose purpose is to find ways to use *less* concrete, or at least less of the cement that binds it together. Today, cement production contributes an estimated eight percent of anthropogenic CO<sub>2</sub> emissions, and its absolute contribution continues to rise in concert with growing urbanization across the planet. These emissions are inherent to its manufacture. They do not include the combustion by which kiln operators—by burning coal, natural gas, or used tires—obtain the 1400+°C required to drive the CO<sub>2</sub> out of limestone (CaCO<sub>3</sub>) and fuse the remaining lime (CaO) with clay minerals to make cement. The atmospheric effects of producing this conventional cement are driving a scientific quest both for new concrete recipes, which might preserve strength and durability while reducing the proportion of cement, and for alternative cements.<sup>8</sup> Research into “low-carbon,” “sustainable,” or “lean” cement draws support from private industrial interests as well as from US infrastructure programs of Defense Advanced Research Projects Agency, the United States Geological Survey, and the National Science Foundation. Still, conventional production and application is likely to be around for the foreseeable future.<sup>9</sup>

Some popular awareness of concrete's other environmental consequences has existed even longer. Ironically, the very thing that makes concrete such a perfect building material—it's strength and durability—also means it is very difficult to reuse, much more so than asphalt, which is the primary

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<sup>8</sup> Jørgen Skibsted and Ruben Snellings, “Reactivity of Supplementary Cementitious Materials (SCMs) in Cement Blends,” *Cement and Concrete Research* 124, no. 1 (2019).

<sup>9</sup> Vaclav Smil, *How the World Really Works: The Science Behind How We Got Here and Where We're Going* (Viking, 2022).

alternative to concrete in many road surfacing projects. The environmental impact of concrete also stems from the fact that it requires extensive gravel mining and the mining of very specific types of sand. Not just any sand will do for concrete. It must be angular, rather than rounded like the abundant wind-blown sands of the Sahara and other deserts. The demand for these sharp-edged sand grains has led to contention in settings as disparate as the river deltas of Southeast Asia and the exurbs of the Colorado Rockies. Cambodian officials have, even after signing a 2017 ban, allowed dredging in the Mekong riverbed to satisfy regional construction's demand for sand, against the interest of many of its own citizens who rely on delta ecosystems for sustenance and income.<sup>10</sup> Homeowners in many North American neighborhoods have organized impromptu environmental coalitions hoping to block plans for new or expanded gravel pits, with the vegetation removal and heavy machinery such operations entail.<sup>11</sup> In major cities, concrete has also been named as a culprit in the urban heat island effect. The material is known to capture the sun's energy and then, in contrast to vegetative landcover, release it slowly back into the air as heat. While this property is used to advantage in places with cold desert nights, it is a distinct disadvantage in the many cities where nighttime could otherwise offer some relief from a warming world.

In this dissertation, however, the most pertinent among concrete's many environmental costs is its relative impermeability, which disrupts flows of surface and groundwater much more than vegetation or soil. As will be discussed much more in the third chapter, this was often the exact intent of putting concrete in urban areas. By preventing precipitation from saturating the earth, concrete created surfaces that were drier, cleaner, and more hospitable to an increasing number of urban Americans. The concrete

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<sup>10</sup> Gerald Flynn and Vutha Srey, "Mining the Mekong: Land and Livelihoods Lost to Cambodia's Thirst for Sand," *Mongabay*, August 29, 2022, [pulitzercenter.org/stories/mining-mekong-land-and-livelihoods-lost-cambodias-thirst-sand](https://pulitzercenter.org/stories/mining-mekong-land-and-livelihoods-lost-cambodias-thirst-sand), accessed February 26, 2025. See also, Vince Beiser, *The World in a Grain: The Story of Sand and How It Transformed Civilization* (Riverhead Books, 2018).

<sup>11</sup> Jason Blevins, "Asphalt, Gravel Demand Is Rising as Residents Near Colorado Mines Push Back against Expansion," *The Colorado Sun* (Denver), March 25, 2024, [coloradosun.com/2024/03/25/gravel-asphalt-plants-colorado/](https://coloradosun.com/2024/03/25/gravel-asphalt-plants-colorado/), accessed February 26, 2025; Andrew Lupton, "Ontario's Aggregate Rules Put Village between Gravel Pit and a Hard Place," *CBC News*, Feb 18, 2025, [cbc.ca/news/canada/london/ontario-s-aggregate-rules-put-village-between-gravel-pit-and-a-hard-place-1.7457695](https://cbc.ca/news/canada/london/ontario-s-aggregate-rules-put-village-between-gravel-pit-and-a-hard-place-1.7457695), accessed February 26, 2025.

infrastructure in US cities today does regularly spare some people from the consequences of heavy precipitation events by impounding water in reservoirs or guiding it into and through stormwater drains. Yet now solid concrete is recognized as part of the impervious surface issue that exacerbates flooding events in major urban areas, often concentrating the consequences into specific neighborhoods.<sup>12</sup>

Over the past twenty years or so, humanists have begun to rescue the topic of concrete from its decades-long relegation to niche circles of chemistry and engineering. Several architectural historians have highlighted concrete's role in aesthetic styles and building techniques.<sup>13</sup> Amy Slaton's 2001 *Reinforced Concrete* brought the topic into science and technology studies, demonstrating that use of concrete for structural elements like walls or bridge decks entailed labor disputes and a new politics of construction.<sup>14</sup> And, while truly centering a material technology remains something of a novelty among academic historians (in contrast to the array of popular histories that have followed Mark Kurlansky's 2002 *Salt*), concrete has recently been the focus of several dissertations.<sup>15</sup> In 2019, Gabriel Lee completed a study of Progressive Era American concrete construction, in which he traces a shifting definition of "modernism": from efficiency and anti-monopoly in uses that aided individual goals such as mobility, to

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<sup>12</sup> Pablo Herreros-Cantis, Lawrence Hoffman, Christopher Kennedy, Young Kim, Joel Charles, Victoria Gillet, Anne Getzin, Danya Littlefield, Alexandria Zielinski, Joanne Bernstein, Rene' Settle-Robinson, Johannes Langemeyer, Marc B. Neumann, Timon McPhearson, "Co-Producing Research and Data Visualization for Environmental Justice Advocacy in Climate Change Adaptation: The Milwaukee Flood-Health Vulnerability Assessment," *Cities* 155 (2024): 105474.

<sup>13</sup> Adrian Forty, *Concrete and Culture* (Reaktion Books, 2012); Manuela Roth, *Concrete: Architecture & Design* (Braun Publishing AG, 2012); Mark Pasnik, Michael Kubo, and Chris Grimley, eds., *Heroic: Concrete Architecture and the New Boston* (The Monacelli Press, 2015).

<sup>14</sup> Amy Slaton, *Reinforced Concrete and the Modernization of American Building, 1900-1930* (The Johns Hopkins University Press, 2001).

<sup>15</sup> Academic histories that center a material technology include Kenneth O'Reilly, *Asphalt: A History* (University of Nebraska Press, 2021), Suzanne L. Marchand, *Porcelain: A History from the Heart of Europe* (Princeton University Press, 2020), and Alan Macfarlane and Gerry Martin, *Glass: A World History* (The University of Chicago Press, 2002). Popular histories include Edmund de Waal, *The White Road: Journey into an Obsession* (Farrar, Straus and Giroux, 2015); Mark Kurlansky, *Salt: A World History* (Walker and Company, 2002); Mark Kurlansky, *Paper: Paging Through History* (W. W. Norton, 2016). In fact, Robert Courland, in *Concrete Planet: The Strange and Fascinating Story of the World's Most Common Man-Made Material* (Prometheus Books, 2011), adopts a similar format to tell a Western civilization story of the material.

brute dominance in uses that aided state control of people and nature.<sup>16</sup> In 2020, human geographer Pryor Placino completed a study of Filipino quarry workers that reveals the global concrete industry's reliance on immediate and individual economic precarities, which complement the industry's future risk via worldwide climate change.<sup>17</sup> In 2021, transdisciplinary humanist Vyta Pivo finished an account of modern concrete's many intersections with American imperial power and a racialized subjection of laborers.<sup>18</sup> Also in 2021, Travis Cook described the nascent cement industry's development in England from 1750-1850, and the transfer of that industry's knowledge to the United States.<sup>19</sup> The history that follows here benefited from each of these studies, which together have added more nuance and a wider perspective on the history of modern cement and concrete.

What sets this dissertation apart, however, is its dedication to revealing what cement was doing. Previous studies have made important points about cement and concrete as a legacy of transatlantic scientific and industrial regimes, a preferred tool of political and economic movements, and an object central to labor disputes and supranational power. All of this was true, and all these perspectives are worthy because cement became so ubiquitous in the twentieth century. That point is where this study begins. Even when other histories of cement and concrete look at earlier antecedents or subsequent global economies, they all relate in some way to a phenomenally transformative episode in the American cement industry that began around 1890. That year, the American domestic output of ~1.3 million tons fell far short of national demand, which was still largely satisfied by imports. But in the ensuing two decades, the domestic industry added new sites and employed new techniques such that in 1910 US production

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<sup>16</sup> Gabriel Lee, "Concrete Dreams: The Second Nature of American Progressivism" (PhD diss., Stanford University, 2019).

<sup>17</sup> Pryor Placino, "Cracking the Concrete: Hidden Livelihoods and Building Possibilities" (PhD diss., Western Sydney University, 2020).

<sup>18</sup> Vyta Pivo, "The Gospel of Concrete: American Infrastructure and Global Power" (PhD diss., The George Washington University, 2021).

<sup>19</sup> Travis J. Cook, "The Second Stone Age: Sustainability, Cement Transitions and Making the Concrete Cornucopia, 1750-1850" (PhD diss., Arizona State University, 2021).

approached 15 million tons, more than ten times the 1890 figure.<sup>20</sup> Considering the events that occurred across nearly two centuries, the 1890 to 1910 period was cement's tipping point.

Those who knew the cement industry recognized its astounding development at the time, and from the turn of the century to the 1940s several men published their own accounts of the marvelous increase.<sup>21</sup> Volumes written by industry insiders tout the innovative industrial engineering, creative advertising, and strategic corporate management that elite engineers and businessmen employed in scaling up cement production. They also record some impressive statistics on rock, human labor, cloth sacks, and the other material requirements necessary for increasing production so drastically. The writings of this era also have obvious deficiencies. Some were unavoidable: They could not know that future production would dwarf the levels they found so astounding. For instance, in several individual months of 1970 US producers generated 7.5 million tons of cement, or half what was produced in all of 1910.<sup>22</sup>

But other deficiencies of the early histories were deliberate and unsurprising. Most authors portrayed the pioneering businessmen as heroes rather than offering any critical investigation of cement origins and the appeal of these materials to consumers. Writers also fixated on fantastic early notions that every American neighborhood would soon consist of entirely concrete roads and homes, at the expense of accounting for the myriad uses that were already becoming ubiquitous. Moreover, they did not consider how cements were changing American society beyond the narrow intentions of civil engineers and home builders.

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<sup>20</sup> Edwin C. Eckel and Ernest F. Burchard, *Portland Cement Materials and Industry in the United States* (Washington, DC: Government Printing Office, 1913), 32.

<sup>21</sup> Uriah Cummings, *American Cements* (Boston: Rogers & Manson, 1898); Robert W. Lesley, *History of the Portland Cement Industry in the United States* (Chicago: International Trade Press, 1924); Joseph S. Young, *The Cement Industry – Its Origin and Growth* (The Princeton University Press, 1939); Earl J. Hadley, *The Magic Powder: History of the Universal Atlas Cement Company and the Cement Industry* (New York: G. P. Putnam's Sons, 1945).

<sup>22</sup> R.A. Whitman and R.E. Ela, "Cement, Monthly" reports for 1970, Mineral Industry Surveys, Bureau of Mines, US Department of the Interior, archived in Cement Statistics and Information, National Minerals Information Center, [usgs.gov/centers/national-minerals-information-center/cement-statistics-and-information](https://www.usgs.gov/centers/national-minerals-information-center/cement-statistics-and-information), accessed February 26, 2025.

A more careful history of cement points to a physical quality that made it culturally important for empires, both ancient and modern, that is surprisingly overlooked: the ability to separate and impede. In modern cement this quality was fostered by scientists and engineers but also emerged from a broad set of cultural interactions that affected all classes, genders, and communities in the United States. “Cementing America” adds to this new wave of concrete scholarship through its emphasis on concrete as an active participant, worthy of knowing beyond its ability to be culturally inscribed and even beyond its implications to economic structures. This is therefore an account of cement itself, what it was and what it did, with a focus on the continuity of cement as a barrier material from the Canal Era through the end of the Cold War.

To this end, the dissertation relies on neo-materialist theory, a broadly environmental framework for researching nonhuman matter’s effects on past humans, individual and collective.<sup>23</sup> Studying matter as playing a part in history resonates with the recent tendency of humanist scholars to describe things and places as more-than-human, a phrase that, sometimes consciously and sometimes not, advances ancestral Indigenous American practices of recognizing all products and practices as co-creations of people and nonhuman entities.<sup>24</sup> The neo-materialist approach, specifically, is undergirded by Bruno Latour’s articulation of distributed agency, which similarly breaks down distinction between human society and nature.<sup>25</sup> It also draws from and contributes to a literature by historians of environments and historians of technologies, in which the volume *New Natures* is a cornerstone. In *New Natures*, editors Dolly Jørgensen, Finn Arne Jørgensen, and Sara Pritchard assert that “not all historical contingencies emanate

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<sup>23</sup> Timothy J. LeCain, “Against the Anthropocene, A Neo-Materialist Perspective,” *International Journal for History, Culture and Modernity* 3, no. 1 (2015): 1–28.

<sup>24</sup> David Abram, *The Spell of the Sensuous: Perception and Language in a More-Than-Human World* (Vintage Books, 1997); Robin Wall Kimmerer, *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants* (Milkweed Editions, 2013); Adrian Franklin, ed., *The Routledge International Handbook of More-than-Human Studies* (Routledge, 2023).

<sup>25</sup> Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford University Press, 2005).

from humanity.”<sup>26</sup> Indeed, nonhuman or more-than-human objects, organisms, and systems have factored into developments of society. This nonhuman influence is now abundantly studied in the form of animal and landscape histories.<sup>27</sup> The historian Timothy LeCain, for example, reveals how non-human materials like copper, silk, and bovine livestock helped to create human cultural and political history in both the United States and Japan.<sup>28</sup> The material scientist Ainissa Ramirez has similarly contributed to the history of copper, arguing that its use in wires not only sped up communication but also “shaped information and meaning.”<sup>29</sup> As historian of modern science and technology Evan Hepler-Smith says, such conclusions demonstrate how “history that gives things their due can be history that better recognizes people, too.”<sup>30</sup> Ramirez herself puts a forward-looking twist on it, saying, “in order to create the finest version of ourselves, we need to think critically about the tools that surround us.”<sup>31</sup>

In addition to better understanding the anthropogenic mineral of cement itself, “Cementing America” also attempts to join the historians of environment and technology who have moved away from theories of a strictly iterative back-and-forth between supposedly distinct cultural and natural realms. Historians Jeffrey Stine and Joel Tarr pointed out the tendency to fall back on such relational theories in

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<sup>26</sup> Dolly Jørgensen, Finn Arne Jørgensen, and Sara B. Pritchard, eds., *New Natures: Joining Environmental History with Science and Technology Studies* (University of Pittsburgh Press, 2013), 4.

<sup>27</sup> For examples of animal histories, see Virginia DeJohn Anderson, *Creatures of Empire: How Domestic Animals Transformed Early America* (Oxford University Press, 2004); Brett L. Walker, *The Lost Wolves of Japan* (University of Washington Press, 2005); Bathsheba Demuth, *Floating Coast: An Environmental History of the Bering Strait* (W. W. Norton & Company, 2019); Jamie Kreiner, *Legions of Pigs in the Early Medieval West* (Yale University Press, 2020). For landscapes, see David Andrew Biggs, *Quagmire: Nation-Building and Nature in the Mekong Delta* (University of Washington Press, 2010); Sara B. Pritchard *Confluence: The Nature of Technology and the Remaking of the Rhône* (Harvard University Press, 2011); Andrew Needham, *Power Lines: Phoenix and the Making of the Modern Southwest* (Princeton University Press, 2014).

<sup>28</sup> Timothy J. LeCain, *The Matter of History: How Things Create the Past* (Oxford University Press, 2017).

<sup>29</sup> Ainissa Ramirez, *The Alchemy of Us: How Humans and Matter Transformed One Another* (The MIT Press, 2020), 49.

<sup>30</sup> Evan Hepler-Smith, Review of *The Matter of History: How Things Create the Past*, by Timothy J. LeCain, *Environmental History* 24, no. 3 (2019): 616–618.

<sup>31</sup> Ramirez, *The Alchemy of Us*, xv.

their 1998 “At the Intersection of Histories: Technology and the Environment.”<sup>32</sup> Immediately, scholars began formulating an alternative theory that better represents the complex co-emergence of technology, society, and environment as appears to have been the true nature of history.<sup>33</sup> A theory of fundamentally conjoined people, places, and things is always in the background of “Cementing America,” even when it is not specifically referenced.

Relatedly, this project has benefitted from the description by geographers Elyse Stanes and Chris Gibson of all materials as “in-process.” Stanes and Gibson used this term in contrast to “raw” materials, which assumes a specific and predestined use guided by an all-powerful human agency. In-process materials, instead, have emerged from a particular genealogy of relationships and will continue to emerge relationally whether or not human intents are any factor at all.<sup>34</sup> Cements, with their long and significantly unknowable geologic histories and their characteristic endurance beyond the lifetimes of human co-creators, are easy to understand as in-process. Other geographers, notably Creighton Connolly, have informed this dissertation through their expansion of the term “urbanization” to define a process that has not truly been confined to metropolitan spaces.<sup>35</sup> The primary examples in “Cementing America” come from conventionally urban locations in Philadelphia, Greater Chicago, and Portland, Maine. Several secondary examples, however, like county jails in Central Pennsylvania or ranch-style homes in Eastern Montana come from spaces that would meet most definitions of rural. With this broader understanding of “urbanization,” virtually every application of cement to alter environments has been an urban structure,

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<sup>32</sup> Jeffrey K. Stine and Joel A. Tarr, “At the Intersection of Histories: Technology and the Environment,” *Technology and Culture* 39, no. 4 (October 1998): 601-40.

<sup>33</sup> For how germane ideas of co-emergence were in 1998, see several essays in “Chapter 1: What is Technology?,” in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in American Technology* (Houghton Mifflin Company, 1998). For subsequent articulations of theory, see Martin Reuss and Stephen H. Cutcliffe, eds., *The Illusory Boundary: Environment and Technology in History* (University of Virginia Press, 2010); Jorgensen, Jorgensen, and Pritchard, eds., *New Natures*.

<sup>34</sup> Elyse Stanes and Chris Gibson, “Materials That Linger: An Embodied Geography of Polyester Clothes,” *Geoforum* 85 (2017): 28.

<sup>35</sup> Creighton Connolly, “Urban Political Ecology beyond Methodological Cityism,” *International Journal of Urban and Regional Research* 43, no. 1 (2019): 63-75.

no matter its location. Moreover, we see that cement was prominent among the environment-shaping materials that gave a second direction to American urbanization. Though that process is more often understood as a migration of people into cities, it was also a process of industrial materials extending out into development that knit together more places according to a common framework of living.

### An Overview of Cementing America

As noted above, one of the features that sets this dissertation apart from other recent work is the theme of separation, division, bounding, and control. Cement's ability to separate and impede showed up in structures big and small. The large concrete creations are likely what first comes to mind at the mention of cement construction history. Hoover Dam is particularly iconic, though a stacked set of interchanges on the Interstate Highway System would work as well. Rather than a study of such massive structures, however, what follows here is a more intimate look at cement in American history revealing the everyday encounters of Americans and cement. These smaller scale engagements not only help account for the proliferation of concrete, but they also show cement's involvement in co-creating several pervasive and powerful American cultures. Concrete, once in place, was often taken for granted, but that hardly made it inconsequential to the ensuing history. To the contrary, this often-invisible ubiquity was central to its influence. Widely viewed as a moldable, durable, lifeless medium of cultural expression, concrete became an active agent in shaping and sustaining a critical set of societal beliefs and actions.

### Chapters of Cementing America

The predominant variety of cement used in the expanding United States during the period covered here actually changed twice, first from common lime to natural hydraulic and then to synthetic hydraulic.<sup>36</sup> This was not a neat, linear process. Cement production varied by place and time, according to

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<sup>36</sup> Harley J. McKee, *Introduction to Early American Masonry, Stone, Brick, Mortar, and Plaster* (Washington, DC: National Trust for Historic Preservation, 1973).

factors both within and beyond human control. Chapter one, “Toward a More Perfect Union,” thus considers the development of cement materials as a process in which geologists, engineers, and chemists collaborated to continuously refine cement’s properties of cohesion and water resistance. It takes as a starting point for this process the rising interest in cement properties during the Canal Era, which in England began circa 1760 and in the United States by 1800, all the way into the Concrete Age that took shape circa 1890.<sup>37</sup>

Cements were a product of select minerals extracted from specific places. Production of lime, a binding powder in many ways similar to modern cement but less potent and much less water resistant, was a well-established component of colonial societies before American independence. Lime producers sought the purest limestones to kiln into brilliantly white powders, but engineers began to value impure limestones that produced a mortar better for holding together stones in various civil and military projects. A distinct cement industry in the United States developed around outcrops of tinged limestone that yielded so-called natural cement. Over the course of several decades, and thanks to European developments in industrial chemistry as well as the establishment of industry-oriented postsecondary education in the United States, dependence on finding the perfectly tinged limestone was replaced by recipes for synthesizing cements that were equally cohesive and water-resistant. Into the twentieth century, cement scientists continued to standardize production via microscopy and chemical analyses, while civil engineers and contractors developed practices of batching and mixing concrete that preserved as much of cement’s barrier potential as possible.

In the first of three central case studies, chapter two, “Environments of Confinement,” follows the history of American prison architecture from the earliest years into the Concrete Age. It tracks the development of using cement for cellular separation as it paralleled the increase in lime production and

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<sup>37</sup> James E. Held, “The Canal Age,” *Archaeology Magazine* (July 1, 1998), [archive.archaeology.org/online/features/canal/](https://archive.archaeology.org/online/features/canal/), accessed March 3, 2025; Ronald E. Shaw, *Canals for a Nation: The Canal Era in the United States, 1790-1860* (University of Kentucky Press, 1990).

the shift toward more specialized cement production over the first century of US history. The prison reforms promoted by social elites followed from the masonry construction technologies, notably lime and other cement precursors, that were increasingly available. Reformers believed cemented structures that channeled water, air, food, and people could also guide convicts to moral rehabilitation. Eastern State Penitentiary, long one of the foremost models for prison architecture, demonstrates the way eager architects, bankrolled by generous public funds, created solid barriers around prisoners. The Eastern State case study also shows the dynamic and troubling relationship between cement, ideas of forcing penitence, and psychological injuries from incarceration.

Chapter three, “Cement Surfaces in the City,” looks at what happened when cement, previously used for major sewer projects, rapidly became a part of a new urban walking experience. Most of the streets in a mid-nineteenth century US city were still unpaved stretches that became alternately muddy and dusty with the weather. Mud could slow down the progress of pedestrians, while either condition could literally mark a walker as having lower social status, a part of the dirty and wet outdoor world rather than someone befitting clean, dry, and sanitary indoor environments. Beyond perhaps a few blocks of flagstone or granite pavers, it was up to individuals to look out for themselves by wearing sturdy leather boots or rubber overshoes. In the 1870s and 1880s, proliferating brick and boardwalk sidewalks began to afford some pedestrians a better experience, while at the same time horsedrawn streetcars made walking in roads more of a liability than ever. The wave of cement sidewalk construction that followed set a new standard for what pedestrian infrastructure could and should be, while also redefining the social stratification of mobility and shaping new cultures of civics and fashion.

Chapter four, “From Sickly Cellars to Beneficent Basements,” recounts cement’s role in making the domestic subterranean environment a respectable space for middle-class Americans. Public health reformers in the mid-nineteenth century had a special interest in keeping families with children from living in basement apartments, which they understood (probably correctly) as inherently unhealthy due to dark, damp, and dirty conditions. At the same time, some Americans with cellars began to construct

cement or concrete floors, primarily to secure the space against rats and groundwater thereby better preserve the food and fuel supplies often stored underground. By the 1890s, due to new furnace technologies, fully excavated cellar spaces were common across much of the northern tier of the United States. Concrete floors were then often a standard feature. When applied in floors or as mortar in brick foundation walls, cement was helping reshape the cellar environment, making the spaces cleaner and lighter and protecting the heating systems that improved air circulation. At the turn of the century, this semi-cemented domestic subterranean remained a space of utility and where coal men and servants, if anyone, worked. Yet the number of American families with hired help was decreasing. In their stead, middle-class female homemakers went down into the increasingly cemented cellar to do laundry, feed furnaces, and, at the prompting of domestic advice writers, experiment with new ways of mothering underground.

Chapter five, “Safe Basements,” continues the history of cement in the domestic subterranean into the middle of twentieth-century America. Fully cemented basements, meaning those with poured concrete foundation walls, gave American homeowners confidence to invest in underground living and encouraged a new culture of renovating basements into spaces for fun and relaxation. In the postwar era, concrete basements became a space of practicing a radically private recreational life that was recognized nationally even though it was more common in specific regions. This recreation was often at the level of the family unit and a few close friends, but it occurred also among individual family members who made their own niches in the clean and secure basement space. A case study of suburban Skokie, Illinois demonstrates that concrete sealed off the domestic subterranean to an extent that made remodeling and renovation projects both immediately practical and a likely pay off upon resale of the home. Throughout this history, the stakes of basement impermeability increased as Americans went from worrying about flooding to anticipating nuclear attack to recognizing the invisible threat of radon exposure.

### The Profound Products of Living with Cement

In the twentieth century, virtually all Americans practiced at least a few common cement cultures and would have recognized cement cultures that they did not know personally. Thousands had spent a night or many weeks isolated in a concrete cell, and others worked a solitary cellblock as guards. Millions had worn light canvas sport shoes or gleaming high heels or roller skates on city sidewalks, or else had taken note of another's fun footwear. Many had played a board game or watched TV in a warm, dry basement, and many more would come to see that experience displayed on their own TV, wherever it was. Cement was not in the background of incarceration, pedestrianism, and underground domesticity. And it was more than a serendipitously available tool by which people realized their preconceived desires for how each of those realms of culture should look. Instead, the cement present in prisons, sidewalks, and home basements was a carefully selected participant that helped gradually shape American cultures in its own ways.

To be sure, people partnered with cement because they understood it, having observed what similar or even self-same materials did in existing applications. Yet through each new application they welcomed cement to be a co-creator in societies largely yet unknown. Now, we can look back and see what transpired in those partnerships. In doing so, we should remember that cement was a partner that many people chose but that many more people lived with. The former group, consisting of professional engineers and weekend home improvers, are important and will receive credit. However, the history that follows will continually turn toward the latter, more expansive group, the people who lived with cement. They came to include millions of everyday Americans who were nonetheless co-creators of American cement cultures. Through tracing these quotidian, intimate relationships between people and cement, we can see in what ways cement made America.

The cementing of America began with a network of scientists and engineers, many of whom dedicated years of labor to tangible knowledge of what cement was and what it could be. By turning that knowledge into more reliable cement productions, they laid the foundations of a society where concrete

consumption is second only to water. As chapter one makes clear, their figurative foundation laying was a far more protracted and halting process than the literal foundation laying with which concrete would eventually become so deeply associated.

TOWARD A MORE PERFECT UNION: THE CONTINUOUS  
REFINEMENT OF CEMENT’S COHESION AND WATER  
RESISTANCE FROM THE CANAL ERA TO THE CONCRETE AGE

Cement science suddenly appeared in news feeds and on popular science websites in the first week of 2023. Email notifications helped me literally ring in the new year as colleagues and family members took note. A team of researchers, mostly affiliated with MIT, had just published in the journal *Science Advances* on the apparent “self-healing” capabilities of cemented structures in ancient Rome. Their paper, “Hot Mixing: Mechanistic Insights into the Durability of Ancient Roman Concrete,” was an exclamation point on a larger body of work that went beyond this team of civil and environmental engineers.<sup>38</sup> For more than a decade, investigations by engineers from several institutions had been supplemented by input from mineralogists and materials scientists. They all sought to solve the riddle of Roman concrete’s durability.

If people today know one thing about the history of concrete, what they know is likely the fact that concrete existed in ancient Rome. Better understanding the history of cement science in the United States requires, at once, broadening this appreciation of Roman cement and eschewing it altogether. Most people who know of Roman cement associate its use with buildings including the dome atop the second-century Pantheon in Rome’s Historic Center district. In this single example, the most obvious properties of cement are plasticity to create the smooth, rounded shape and endurance to last for nineteen centuries.

Other applications of Roman cement reveal more properties to consider. Cement contributed significantly to the development of reservoirs and aqueducts for managing and distributing water resources, as well as to maritime structures including the artificial harbor built at Caesarea in what was

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<sup>38</sup> Linda M. Seymour et al., “Hot Mixing: Mechanistic Insights into the Durability of Ancient Roman Concrete,” *Science Advances* 9, no. 1 (January 2023).

then called Roman Judea during the first years of the Common Era.<sup>39</sup> These broader uses demonstrate that, in addition to plasticity and durability, Roman cements and concrete mixes had hydraulic properties. They could set and harden underwater, as evidenced by harbor construction at Caesarea, and they were to some degree impermeable, as evidenced by their use for containing water within aqueducts and reservoirs. These qualities of the cements applied across the Roman Empire are a key to understanding the modern history of cement science and the material's applications in the United States.

That said, English and American fascination with modern concrete's connection to Roman engineering has a tainted history. A swell of claims that cement was a technology inherited from the Romans developed in the late nineteenth century. To a degree those claims ring nearly so hollow as cement brands' contemporaneous deployments of Egypt's Sphinx (not built with any cement) and the Greek Titan Atlas (a mythological figure).<sup>40</sup> It is no coincidence that during the same period of US imperial ascendance a class of ethnically homogenous American elites imagined their place in history with explicit rhetoric of "civilization" and racial hierarchy. Proclaimed inheritance of Roman technologies could intermingle to justify abusive relationships across scales and geographies.<sup>41</sup> Insofar as US engineers latched onto the same properties of cement that Romans did, this was no sign that some metaphorical torch had been passed to them from the ancient imperial world. Instead, it was the re-emergence of a power-yielding relationship between people and minerals.<sup>42</sup>

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<sup>39</sup> For general uses of the cement based on pozzolan (volcanic ash) that the term "Roman cement" is typically meant to describe, see Norbert J. Delatte, "Lessons from Roman Cement and Concrete," *Journal of Professional Issues in Engineering Education and Practice* 127, no. 3 (2001):109-115. For the specifics of the Caesarea project, see Robert L. Hohfelder, Christopher Brandon, and John P. Oleson, "Constructing the Harbour of Caesarea Palaestina, Israel: New Evidence From the ROMACONS Field Campaign of October 2005," *International Journal of Nautical Archaeology* 36, no. 2 (2007): 409-415.

<sup>40</sup> For the materials that were used in building the Sphinx, see Mark Lehner, "Reconstructing the Sphinx," *Cambridge Archaeological Journal* 2, no. 1 (1992): 3–26. For more on Atlas Cement, see Earl J. Hadley, *The Magic Powder: History of the Universal Atlas Cement Company and the Cement Industry* (New York: G. P. Putnam's Sons, 1945).

<sup>41</sup> This is a throughline of Pivo, "The Gospel of Concrete."

<sup>42</sup> For evidence that human social power and the power of things are inseparable, see Edmund Russell, James Allison, Thomas Finger, John K. Brown, Brian Balogh, and W. Bernard Carlson, "The Nature of

The increased attention to Roman concrete in recent years, while vulnerable to the same simplistic narrative of civilization continuity, has at its core a significant difference that makes the whole topic quite interesting. That difference is humility. Contemporary cement scientists who investigate the durability of historic concrete operate with a recognition that modern cement engineers, aside from not yet having perfected this ancient technology, do not even fully understand cement’s potential behaviors over time and within various environmental scenarios. This humility extends into envisioning the future. Where previous generations of American cement scientists predicted concrete as a permanent and enduring solution to society’s straightforward structural needs, many cement scientists today acknowledge that concrete, societies, and the surrounding environment will all change over time.<sup>43</sup> Their interest in “self-healing” concrete proceeds from expecting instability and hoping that careful construction practices can create, in their words, sustainability and resilience.<sup>44</sup>

We might pause when professional engineers admit that they are still learning about how cement behaves—how concrete systems can disassemble and reassemble over months, decades, and centuries. Most of us, if we think of concrete at all, think of it as inert. From such a position, even the existence of ongoing cement science might be a surprise. But in truth, the ongoing science of cement is rich, revealing, and tied to history. And cement science’s own history shows that modern cement is a dynamic, complicated, and in fact diverse array of materials and practices with immense environmental and social consequences embedded in their production and use.

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Power: Synthesizing the History of Technology and Environmental History,” *Technology and Culture* 52, no. 2 (April 2011), 246-259.

<sup>43</sup> For a succinct example of permanence associated with concrete, note a claim the material had “maintenance built right into it” in Portland Cement Association, *Progress Review of Twenty Years: Issued by Portland Cement Association in Commemoration of Its Twentieth Anniversary Meeting* (1922), 3, CHM.

<sup>44</sup> For an example of this humble approach and its aim to generate more sustainable building options, see Giacomo Eramo, Marina Clausi, Giovanna Fioretti, and Daniela Pinto, “The Use of Lime over the Centuries: The Complexity of the Apulian Built Heritage,” *Minerals* 14, no. 1 (2024).

Over the course of many decades, people in the United States came to take their dynamic relationships with cement for granted. This chapter shows that those subconscious everyday relationships resulted from thousands of extremely conscious and tangible relationships between people and cement-yielding minerals over the preceding generations. The history of modern cement science and technology is best understood as a network of intimate connections between minerals and people. The network was constantly shifting and spreading as new chemists or entrepreneurs joined and as they auditioned new mineral materials for a role in the making of cement. And yet, despite incessant change, the network was consistently defined by two factors. First, the hydraulic, or water-resistant, properties that some mineral ingredients yielded and, second, the exciting visions those properties engendered in the minds of engineers who sought to regulate environmental flows of organisms and matter.<sup>45</sup>

To the extent human-built structures achieved regulation of environmental flows, they did so by being effective barriers. In the long nineteenth century, scientifically standardizing cement production toward more reliable barrier materials was a transatlantic project to which an array of scientists and engineers contributed. In the United States as in England and elsewhere, entrepreneurial industrialists and geological surveyors sought out the best rocks to kiln, chemists tried to identify the requisite cement ingredients, and civil engineers envisioned the ideal admixtures or structural configurations by which to build completely cohesive barriers. The goal of cement production, shared by chemists and civil engineers alike throughout the nineteenth century and into the twentieth, was to create a material that could fill voids and seal surfaces. Over that same period, the material's application spread from niche use in canals and harbors to a burgeoning assortment of pavements, foundations, and walls.

Cement science's consistent focus on creating barriers in the built environment can get lost in the industry's history. Existing accounts of cement typically begin with some consideration of the pre-1850

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<sup>45</sup> For more on the differences among cementitious materials, especially in terms of hydraulic properties, see Harley J. McKee, *Introduction to Early American Masonry, Stone, Brick, Mortar, and Plaster* (Washington, DC: National Trust for Historic Preservation, 1973), 68.

canal period and the superlative barrier effects that various early industrialists found to result from taking specific limestones, crushing them, and kilning them at blistering temperatures. Thereafter, however, other histories transition toward either the engineering of iconic concrete structures or the business and marketing tactics that corporate officials used to grow brands and consolidate markets around the turn of the twentieth century. Both cast the earlier period of cement science as simply a prerequisite to grand concrete megaprojects of twentieth-century America, from the Panama Canal to Grand Coulee Dam to the J. Edgar Hoover Building. This belies the true relationships between early cement scientists and mineral materials, and it causes cement itself to somehow disappear amidst the subsequent money and power of renowned structures, venerated names, and national glory.

This chapter holds the focus on physical relationships between cement and people that persisted even through the turn of the twentieth century. It gives primacy to the intimate interconnection of people and minerals, even as American cement producers achieved brand recognition, increased production to over two million tons annually, and became associated with well-known megaprojects. This more human-scale history of cement science leads to an overall new history of cement. In this history, the result of standardized and voluminous cement production was not simply that more people experienced indirect effects from new infrastructures or that they saw and knew about iconic buildings. The result was also that almost every person in the United States lived in direct relationship with cement and the concrete in which it is used. They drank water from cement-lined reservoirs, walked to a streetcar via concrete sidewalks, had their home heated by a furnace that sat in a concrete basement, and flushed their waste into concrete sewer mains. In each of these relationships with an application of cement, the continuity of cement's barrier properties is apparent. The history of American cement science, from its imperial eighteenth-century origins through its professionalization in the late 1800s, is a history of minimizing porosity in the built environment and thereby fostering cement's power over natural movements of liquids, gases, and organisms.

The Imperial Pursuit of Impure Limestones

Search the internet for a history of concrete and you are bound to find one that begins with John Smeaton in eighteenth-century England. Smeaton did not use concrete, but he is linked to the modern proliferation of cement. Cement was formerly a broad term for any material that bound one thing to another and is now a term most often used to describe a very narrow range of chemically active mineral powders that can bind together sand and gravel into concrete. In the context of Smeaton, cement is perhaps best used to mean something slightly less specific than the latter: any product of kilning limestone that was intended for masons to mix with sand and water to make a mortar. (Mortar is the paste that hardens into a binder for structures of brick or stone.) Many have credited Smeaton with laying cornerstones both literal and metaphorical by his use of cement in modern construction practices.<sup>46</sup> To some extent, such accounts stoop to the fallacy of the individual genius or the “father of” trope and miss the important context of widespread lime kilning that occurred throughout much of the transatlantic world in the eighteenth century. In such a context, many people on multiple continents developed knowledge of and applications for a range of cement products.

And yet, the emphasis on Smeaton makes sense for two reasons. The first is that modern cement knowledge proliferated through imperial and learned networks because of members like Smeaton who took an interest in the subject. Born in 1724 to an upper-class family near Leeds, Smeaton’s social position and education led him into Birmingham’s famous Lunar Society. Typical of his learned peers, Smeaton’s adulthood featured a range of experimental and professional endeavors that for a time consisted mostly of making mathematical instruments. Ultimately his career was defined by the harbors, canals, and bridges he designed across Great Britain, from the Cornish Peninsula to the Aberdeenshire

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<sup>46</sup> For examples of chronicles that begin with Smeaton, see Wilhelm Michaelis, *Die hydraulischen Mörtel, insbesondere der Portland-Cement in chemisch-technischer Beziehung für Fabrikanten* (Berlin: Quandt & Händel, 1869); William G. Hartranft, *Notes on American Cement* (Philadelphia: Commercial Wood and Cement Co., 1896), 5-6; Robert Courland, *Concrete Planet* (Prometheus Books, 2011).

coast. Remarkably, his first civil engineering project became his legacy. In 1756, the president of London's Royal Society recommended that Smeaton be commissioned to plan and execute a lighthouse situated well into the English Channel south of Plymouth, meant to warn ships of a rock ledge that was concealed at high tides. This would be the third navigational structure on this ledge, called the Eddystone Rocks. The first had been cyclonically obliterated in 1703 just five years after completion and the second, more stormproof version burned in a tragic lantern accident that also ended the keeper's life in December 1755.<sup>47</sup>

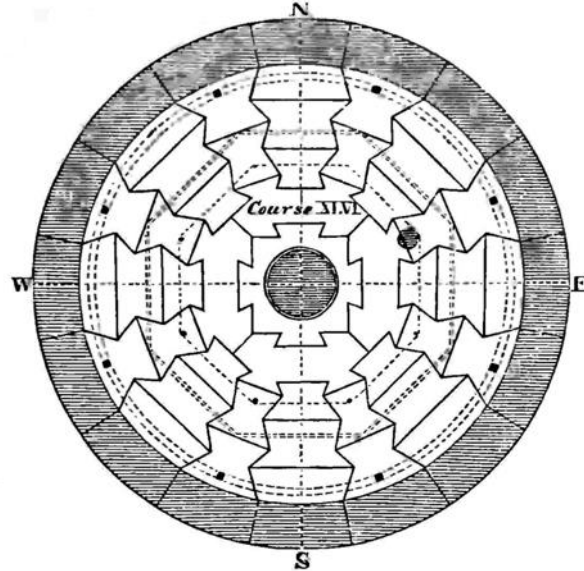
Emphasizing Smeaton in modern cement history also makes sense because of what exactly he contributed to cement science. Smeaton specifically designed his edition of Eddystone to outlast the previous models, a goal his lighthouse would easily achieve. In addition to employing a concave cone for further wind-proofing, he also minimized use of wood in favor of granite and limestone. Perhaps most importantly, masons bound all the carefully curved stones with hydraulic lime mortar.<sup>48</sup> Again, hydraulic meant that the mortar would set underwater, harden into a stonelike mass, and then resist the weathering and dissolution that water is capable of effecting on most mineral structures. Smeaton did not invent hydraulic mortar nor its intentional use in construction. Rather, he conspicuously selected material with hydraulic properties and advertised that this material was key to a successful Eddystone structure. To find the preferred properties, he experimented with various mineral powders transported great distances, many from the Bristol Channel region but others from the Dutch Republic and, yes, Rome.<sup>49</sup> Eddystone therefore demonstrates Smeaton's significant role in transforming the theretofore local issue of mortar qualities into a matter of widespread scientific and imperial interest in the Anglophone world.

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<sup>47</sup> See "Winstanley's and Rudyerd's Lighthouses" and "Smeaton's Lighthouse on the Eddystone" in Samuel Smiles, *Lives of the Engineers, with an Account of Their Principal Works* (London: John Murray, 1861), 16-48.

<sup>48</sup> F. M. Lea, "Hydraulic Cements," *Science Progress* (1933-) 30, no. 117 (1935): 31-41.

<sup>49</sup> Hugh Torrens, "The Somersetshire Coal Canal Caisson Lock," *Bristol Industrial Archaeology Society Journal* vol. 8 (1975), 5.



PLAN OF THE 46TH COURSE, SHOWING THE  
METHOD OF DOVETAILING.

Figure 1.1. Plan of the 46th layer of interlocking stones in Smeaton's design of the third lighthouse on the Eddystone Rocks. Published in Smiles, *Lives of the Engineers* (1861).

The design of Eddystone reveals the type of thinking to which hydraulic mortars were both companion and facilitator. That thinking centered on cohesion as a means to impenetrability or, at the least, sufficient resistance to movement. Smeaton's design for interlocking concentric walls of cut stone, shown in layer-by-layer cross-sectional plans of the Eddystone tower (Fig. 1.1.), complemented the enduring cohesiveness of hydraulic mortar. The lighthouse, a tall pile of stones surrounded by the windward end of a large sea channel, was relatively sealed from the elements on account of how densely those stones had been assembled.

Over the subsequent quarter-century, tightly fitting stones together and filling their joints with hydraulic mortar was a hallmark of Smeaton's civil engineering works. That multiscale cohesion was characteristic of his other famous designs that were large, outdoor structures including canals, bridges, and harbors that all in some way intended to obstruct the movement of water. However, perhaps no category of work shows Smeaton's attention to detailed stone togetherness like his brewery designs. These entailed room-sized vats in veritable beer factories such as the Royal Brewery at Weevil, which

supplied the king's navy. Throughout the drawings, Smeaton demonstrated his trust in cement and stone to securely contain ales and to exclude any dusty matter or microscopic organisms that would surely compromise the brewery's product.<sup>50</sup>

Smeaton was not alone among elite Europeans in bringing attention to mortars and thereby initiating a set of interconnected scientific and industrial experiments with cement properties that would continue for generations to follow. In 1755, a posthumous publication on medical chemistry by Caspar Neumann noted the similar mineral powders that resulted when one kilned oyster shells and when one kilned limestone. Neumann concluded that both were mostly carbonate of lime, today called calcium carbonate ( $\text{CaCO}_3$ ) and known as a biogenic mineral compound prevalent around the world. Twenty years after Neumann, the French chemist Antoine Baumé contended that shells, whether from sea life or from poultry eggs, in fact produced better lime powder than did stone. Baumé claimed that the combustible material on shells, presumably referring to residues of organic tissue, somehow benefited the chemical transformation that occurred during kilning. This was contrary to the published advice on mortars at the time, which tended to say that the strongest limes resulted from kilning the purest of limestones. Baumé and Smeaton were among those broadcasting a very different message: some forms of carbonate of lime contained desirable impurities.<sup>51</sup>

Over the subsequent decades, new relationships between impure limestone and imperial ambitions developed along the tidal estuaries and coastline of Southeast England, eventually taking the form of royal patents and official businesses. At the center of this human-mineral geography was the Isle of Sheppey, around which the River Medway's water began to mingle with that of the River Thames. Sheppey's short cliffs of crumbly clay afforded industrial entrepreneurs to harvest stones as one might

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<sup>50</sup> "Beer Cisterns (1780) - JS/4/56, "Beer Cisterns" (1782) - JS/4/52v, and "Brewer" (1783) - JS/4/57v, in "Working design drawings of civil engineering projects by John Smeaton, Volume IV - Bridges and buildings drawings by John Smeaton," RS.

<sup>51</sup> J.F. John, *Lime and Mortar in General, and the Difference between Mortar of Shell-lime and Limestone in particular, and the Theory of Mortar*, trans. Alfred Kerksenbrock (Berlin: Duncker and Humblot, 1819), 5-6.

pick apples or, better yet, as one might harvest cucumbers off a trellised wall. Embedded in the loose clay outcrops were nodules of hard rock, more carbonate of lime than clay and yet clearly imbued with the clay as well as a rusty tinge. When kilned and ground, Sheppey stones reliably created powder with hydraulic properties. In 1796, the clergyman James Parker, a resident of nearby Northfleet, registered a patent for collecting and burning these nodules, many small enough to be lifted by hand. The burning reduced the rocks to a powder that had general applications to construction, including stucco work, and was especially suited to what Parker termed “aquatic” uses.<sup>52</sup> The business model of harvesting these rocks from the clay banks would endure for decades, and the burnt products fostered standard expectations for cement materials in England and beyond. From Smeaton to Parker, engineers and producers codified the idea of a “natural cement,” a rock suited to making hydraulic material.

Parker’s patent used language that remained fundamental to modern cement chemistry and geology. Parker called the nodules both “calcareous,” meaning that they contained carbonate of lime or chalk, and “argillaceous,” meaning they had significant clay content. Cement science, however, was far from settled even when it came to the most basic questions. The practices that Parker’s patent codified of searching that coastal region for chunks of rock and trusting they would kiln into hydraulic cement, were neither scalable nor portable. With mortars of increasing importance to domestic and imperial infrastructures around the world, two interlinked threads of research came into focus early in the nineteenth century. One thread involved establishing knowledge of what mineral ingredients created the hydraulic properties and publishing it in widely circulated journals. It wove around a second thread, which involved identifying the rock formations that contained those mineral ingredients.

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<sup>52</sup> A. J. Francis, *The Cement Industry 1796-1914 A History* (Exeter, UK: David & Charles, 1977), 26-32; Summary of a paper, “Parker’s ‘Roman’ Cement,” by A.P Thurston printed as “The History of Cement,” *Nature* 143 (June 24, 1939): 1060; James Parker, “Specification for Cement for Building Purposes,” Royal Patent 2,120, granted 28 June, enrolled July 27, 1796, [cementkilns.co.uk/cemkilndoc006.html](http://cementkilns.co.uk/cemkilndoc006.html); Also, Lesley, 12 (though Lesley mistakenly calls him Joseph Parker).

In the first decades of the nineteenth century, when no US producers had even replicated English natural cement production, a more scientific approach took hold in Europe that would have tremendous consequences for later iterations of the American cement industry. Louis Joseph Vicat was among the first to publish on modern cement science. The French civil engineer had been working on problems of cement, including hydraulic chemistry, since at least 1812. Vicat was motivated by concern that France's goals could be hamstrung when imperial agents tried to build in locations without access to the type of rock that by itself made hydraulic cement.<sup>53</sup> Vicat, a specialist in roads and bridges, published a summary of his experiments in 1817. The following year, the military helped him publish a book, *Recherches Expérimentales sur les Chaux de Construction*, and distribute it throughout France's civil engineering network.<sup>54</sup>

In 1819, the Dutch Society of Sciences held a competition for the best essay on cement chemistry. The prize went to German chemist Johann Friedrich John. The contest served grand imperial interests and yet entailed intimate relationships between people and powder. John, upon dissecting a masonry structure in Berlin, knew the cement had not properly hardened because it still “tasted caustic.”<sup>55</sup> John's tongue thereby added to an array of sensory assessment that included his eyes, which saw the cement generated “milk of lime when mixed with water,” and his ears, which heard the strong effervescence after he dripped acid on carbonate material.<sup>56</sup> John made little distinction between his sensory observations and the results obtained with modern instruments—procedures that largely involved burning or otherwise reacting minerals and then weighing the products.

John's intimate knowledge of various mortars aided the development of a formula for hydraulic cement that could be articulated in the scientific language of chemistry. John opened his 1819 essay by

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<sup>53</sup> Charles Spackman, *Some Writers on Lime and Cement from Cato to the Present Time* (Cambridge, UK: W. Heffer & Sons, Ltd., 1929), 26-27.

<sup>54</sup> L.J. Vicat, *A Practical and Scientific Treatise on Calcareous Mortars and Cements, Artificial and Natural*, trans. Captain J.T. Smith (London: John Weale, 1837).

<sup>55</sup> John, *Lime and Mortar in General...and the Theory of Mortar*, xv.

<sup>56</sup> John, *Lime and Mortar*, 47.

stating that all successes of chemistry meant isolating bodies that had consistent attributes when equally pure.<sup>57</sup> He thereby aimed to define hydraulic cement universally, regardless of its geologic origins, just as previous chemists had done for gelatin regardless of animal, starch regardless of plant, and gold regardless of ore body.

The Dutch Society's prize question contradicted the earlier chemist Baumé. "By what chemical cause does lime from stone generally make a more solid and durable masonry than lime from shells, and what are the means of correcting lime from shells in this regard?" The question reflected the now widespread awareness of lime derived not from pure white outcrops but rather from rocks like the Sheppey stones, which kilned into a powder that generated enough solidity and hydraulic quality as to make Baumé's preference for shell-derived lime laughable. John went so far as to name this product "Caement," a material he recognized as fundamentally different than lime. John determined that these properties developed due to impurities that existed in some limestones, like those at Sheppey, but never in shells, at least not to the same degree. The desirably adulterating chemical bodies were, unlike the limestone's bulk, insoluble in nitric acid. John claimed that these bodies, which he named as silica, iron-oxides, and alumina, comprised from two to twenty percent of the mass in many limestones. Their hardness, even when long submerged in water, accounted for some limestone cements being generally more effective than was shell lime, and especially so for applications in canals and docks.

Despite the concurrent experiments of John and Vicat and the agreement on the origins of hydraulic properties to which they contributed, questions of cement composition continued to receive attention in subsequent years. Among the participants in the late 1820s was Sir Charles William Pasley. Approaching his fiftieth birthday, Pasley was an experienced British military engineer ascending the officer ranks. An expert in demolitions and a published theorist on British imperial policy, Pasley was

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<sup>57</sup> John, *Lime and Mortar*, 2.

then teaching at the Royal School of Military Engineering in Chatham.<sup>58</sup> Only a busy dockyard sat between the school grounds and the River Medway, which, when the tides cooperated, flowed north through Chatham before turning due east and slackening into a wide estuarine stretch. At the other end of the Medway's estuary lay the Isle of Sheppey, the heart of the English cement rock region with its famously accessible stones. Three decades after Parker's patent, the estuary was still known in engineering circles as the most reliable source of rock for producing cement.

As an instructor at Chatham, Pasley aspired to become a chemist and to be recognized as such by the Royal Society. This required some movement away from his roots in engineering, which had its own approaches to questions of hydraulic properties. These differed from the strict categorization by which recent cement chemists had begun defining pure minerals and invisible compounds that did or did not contribute to hydraulic properties. Engineers, more interested in how these materials behaved at the scale of a construction project, rated limestones and their cement products according to a hydraulic spectrum. They employed combinations of the terms *hydraulic*, *water*, *lime*, and *cement* to denote materials that had at least some ability to set and harden underwater and thereafter resist dissolution while submerged.<sup>59</sup> British engineers collaborated with the most hydraulic mineral powders to connect an imperial commercial world via locks along rivers or canals and via docks, such as the Royal Navy's installations at Chatham.<sup>60</sup>

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<sup>58</sup> Sidney Lee, ed., *Dictionary of National Biography, Vol. XLIII Owens—Passelewe* (New York: MacMillan and Co., 1895), 440.

<sup>59</sup> H.S. Dexter, "Observations on Calcareous Mortars and Cements," Communication of the Canal Commissioners, Albany, May 4, 1840, State of New York, Senate 123, 16-17. See also, McKee, *Introduction to Early American Masonry, Stone, Brick, Mortar, and Plaster*.

<sup>60</sup> My use of "collaborated with...minerals" derives from theories of distributed and networked agency made famous by Bruno Latour and, specifically, by recent articulations of neomaterialist theory. For more theory of how materials both constrained and facilitated the past, see LeCain, *The Matter of History: How Things Create the Past*, 38-63, 124-136, and Claire Colebrook, "On Not Becoming Man: The Materialist Politics of Unactualized Potential," in *Material Feminisms*, eds. Stacy Alaimo and Susan J. Hekman (Indiana University Press, 2008), 52-56.

The cement rock at Sheppey and nearby along Great Britain's coastline was therefore fortuitous for state development, which is how Pasley identified cement as a potential bridge between his military commission and his chemistry aspiration.<sup>61</sup> He foresaw a crisis of national security if builders were to exhaust cement sources on the southeast coast. He echoed Vicat's worries about the limits to French imperial development that dependence on naturally occurring cement rocks could present.<sup>62</sup> Foreshadowing other modern nation's programs to synthesize fertilizers or rubber substitutes, Pasley aimed "to form an artificial cement, resembling the natural Water cements in its properties...that such a substitute might hereafter be of great use to the Public." At the same time, he hoped that creating this chemical recipe for a crucial building material of empire would earn him admission to the Royal Society.<sup>63</sup>

To answer these questions, Pasley laid out a research program that was a bit surprising for a respected officer. Unsurprisingly, the then-lieutenant colonel leveraged his position above common enlisted men who shoveled heavy sediments and rocks from several pockets along the Medway's mouth and delivered the bulky material to Pasley's Chatham laboratory. But from there, Pasley preferred to dirty his own hands by kneading together various mineral and organic combinations to see how they behaved after kilning. As for the German chemist John before him, and likely for the Americans who embraced cement chemistry some three decades later, discerning among cement ingredients was a profound sensory interaction. Pasley simply did not trust his workmen to make samples dense and homogenized to the

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<sup>61</sup> For much more on this "cement transition" in Southeast England as an environmental history of British empire and industry, see Travis J. Cook, "The Second Stone Age: Sustainability, Cement Transitions and Making the Concrete Cornucopia, 1750-1850" (PhD diss., Arizona State University, August 2021).

<sup>62</sup> For the specific context circa 1830, when the British Empire was at once homogenizing colonial governance and separating governance from corporate licensing, see Philip J. Stern, "Corporate Innovations: The Age of Reform," in *Empire, Incorporated: The Corporations That Built British Colonialism* (Harvard University Press, 2023), 193–241.

<sup>63</sup> Lieut.-Colonel C. W. Pasley, "An account of experiments tried at Chatham for the purpose of obtaining an artificial water cement," an unpublished paper read to the Royal Society on 17 June 1830, 4, RS.

degree he knew a good cement should be. They did not take “sufficient pains in mixing” to, as Pasley put it, minutely pulverize and intimately mix each combination of ingredients prior to its test.<sup>64</sup>

So, the high-ranking gentleman familiarized himself with mucky cement ingredients, personalizing his pre-kiln observations with notes on what “soiled the hands” or what was “capable of being crushed by the fingers.”<sup>65</sup> Pasley washed and sorted the hydraulic cement mainstays of pure chalk and clay, painstakingly removing any organic matter.<sup>66</sup> He then tested a variety of extra inputs to cement recipes. One set of experiments focused on carbon matter and especially involved several trials with established proportions of coal dust. Another, rangier set tested admixtures of saw dust as well as oils from olives, flax, and whales and tars from coal or pine trees.<sup>67</sup> That final ingredient, then a quite regulated material for coating ships, highlights that Pasley’s program at Chatham revolved around the idea that he could literally put his finger on, and perhaps chemically name, the ingredients that made up a properly waterproof cement. His experiments were the modern cement industry in microcosm: a process of industrial hierarchies in which not even the elite were truly removed from nature by artificial products but were instead simply relating to the nonhuman world in new ways.

In 1830, Pasley presented his Chatham results to the Royal Society, hoping for recognition and publication that was not forthcoming. At the same time his British colleagues demonstrated ambivalence about cement chemistry, the Dutch Society returned to the topic with a new prize question: “What are the characteristics of the cements that harden under water, what are their principal constituents and what are the chemical combinations that take place during solidification?” This time, the Society honored German chemist and mineralogist Johann Nepomuk von Fuchs for a paper that built on John’s previous response, now detailing how silica and lime seemed to partially combine from the heat of kilning.<sup>68</sup> The rather

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<sup>64</sup> Pasley, “An account of experiments tried at Chatham...,” 41.

<sup>65</sup> Pasley, 22, 38.

<sup>66</sup> Pasley, 41.

<sup>67</sup> Pasley, 47.

<sup>68</sup> “John Nepomuk Fuchs” in Spackman, *Some Writers on Lime and Cement...*, 25.

narrow question of what went into hydraulic cements informed bigger questions about modern construction. The mode of constructing canals, harbors, and mills of the industrializing world hung in the balance as Europe's chemists and civil engineers tasted mortars, pounded chinks, kneaded clays, and kilned countless mixes of minerals.

### Finding Natural Cement in the United States

Across the Atlantic, questions of chemistry were initially less important in the nascent American cement industry. Identification of the best cement occurred not in the context of recipes but in the context of rock formations that by trial and error proved to yield hydraulic properties. US cement scientists, to the extent such an identity existed, were not people identifying chemical ingredients but rather those who aided production of hydraulic materials by spending time in the lithic landscape. Prospective American cement producers were therefore prospectors looking to *find* what they perceived as potential cement that existed naturally in rocks across the continent. This contrasted markedly with Vicat, John, Pasley, Fuchs, and the others in Europe who were trying to *make* cement from various ingredients they had on hand.

To be sure, the *find it* approach in the United States was also adopted from England, where it had been codified in Parker's patent. In 1817, a 27-year-old American named Canvass White toured canals across northern England and then returned to New York with a small pile of rock exemplars. White's tour had been arranged by his new employers, who were beginning to plan the Erie Canal. White had to fund his own voyage—an apparent result of tension between bold visions and fiscal apprehensions among the New York politicians in charge of the canal project. Luckily for White, who was still searching for a professional identity after a comfortable upbringing among the Mohawk Valley's merchant class, he could afford it.<sup>69</sup> In his travels, White learned about the established British hydraulic cement industry with its

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<sup>69</sup> Gerald Robert Bastoni, "Canvass White, Esquire (1790-1834): Civil Engineer" (MA thesis, Lehigh University, 1983).

reliance on a few select sources.<sup>70</sup> In addition to the previously described coastal limestone nodules in the Southeast, White learned of the Blue Lias formation, a ribbon of limestone that traverses Great Britain from large outcrops around the Bristol Channel to a terminus on Yorkshire's northeast coast.<sup>71</sup> Learning of these minerals and watching British engineers apply them to make relatively watertight canal structures encouraged White to search for cement-yielding rocks along the Erie's planned path.

The following year, by trial and error of burning limestone chunks in a simple stove-sized kiln, White and his assistants found their quarry. With enough crushing and heating, a rock that outcropped near the intended Erie Canal path, just east of Syracuse, became a hydraulic cement powder. Just as James Parker had done with Sheppey stones two decades before, White laid claim to the outcrop and patented a means of processing it into cement, which he later sold to the State of New York for the considerable sum of \$10,000.<sup>72</sup> By the original Erie Canal's completion in 1825, others had helped identify cement rock sites paralleling much of the project's path from Western New York to the Albany region as well as deposits near Rosendale on the Lower Hudson with which canal construction to the Delaware River commenced.<sup>73</sup> White would go on to aid cement rock identification and canal engineering throughout several industrializing corridors from Connecticut to Pennsylvania.<sup>74</sup>

Nearby outcrops that yielded such a dense, enduring, and waterproof cement were a boon to the construction of an artificial east-west river through New York, perhaps even instrumental to its success. Other Americans who shared the vision of canal-based economic development took note, and waves of

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<sup>70</sup> Richard M. P. Lowry, "In Defense of Natural Cement: A Critical Examination of the Evolution of Concrete Technology at Fort Totten, New York" (MA thesis, Columbia University Graduate School of Architecture, 2013), 6-7.

<sup>71</sup> P.R.N. Hobbs et al., "Engineering Geology of British Rocks and Soils - Lias Group," British Geological Survey Internal Report OR/12/032 (2012), <https://nora.nerc.ac.uk/id/eprint/17270/>.

<sup>72</sup> Lesley, *History of the Portland Cement Industry in the United States*, 13.

<sup>73</sup> Lesley, 17; Richard K. Meade, *Portland Cement, Its Composition, Raw Materials, Manufacture, Testing and Analysis*, 3<sup>rd</sup> ed. (Easton, PA: The Chemical Publishing Co., 1926), 7-8; Harland D. Unrau, *Historic Resource Study: Chesapeake & Ohio Canal* (United States Department of Interior - National Park Service, 2007).

<sup>74</sup> William B. Ashworth, Jr., "Scientist of the Day - Canvass White," Linda Hall Library, September 8, 2021, [lindahall.org/about/news/scientist-of-the-day/canvass-white/](http://lindahall.org/about/news/scientist-of-the-day/canvass-white/), accessed January 21, 2025.

cement prospecting ensued. Attempts to identify cement rock and establish kilns became part and parcel of the nation's program of appropriating and developing land that has traditionally been termed westward expansion.<sup>75</sup> In the mid-1820s, the search for natural cement rocks along the Potomac River intensified.<sup>76</sup> Cement prospectors sought to help realize the longtime popular desire for an artificial waterway onto the Allegheny Plateau that would connect Chesapeake commerce with inland resource extraction. The search proved expensive and frustrating, and canal construction began in 1828 with imports from New York and England supplementing meager local output.<sup>77</sup> Most of the natural cement in the area was, frustratingly, farther inland and tucked into Appalachian folds, such that production there did not benefit the canal so much as it benefited *from* the canal once the Chesapeake & Ohio was near its completion in the late 1830s.<sup>78</sup>

Other Americans had a much more serendipitous encounter with cement rock along the Ohio itself, at the exact rapids-filled stretch that most cargo-filled watercraft had been resigned to portage. By 1829, hydraulic mortars lined a short canal bypassing these rapids at the downstream end of Louisville.<sup>79</sup> As in New York, the rock sources proved so extensive that industrialists established a major and lasting cement district that spanned into Indiana. Between 1820 and 1850, advancing largely hand-in-hand with canal construction, annual domestic manufacture of cement rose from around 25,000 barrels to over one million barrels.<sup>80</sup> This was entirely natural cement, meaning hydraulic cement created by kilning a single source rock without any additives. There was, of course, location-specific variability in the degree of

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<sup>75</sup> Many historians have documented the near-total overlap between sites of canal development and sites of cement production in the United States. The most comprehensive summary of canal projects and cement sources is in Cook, *Second Stone Age*, 239. See also Lesley, 13-14.

<sup>76</sup> The fruitlessness of prospecting for hydraulic lime along the Potomac as late as 1826 is documented in "Message from the President of the United States Transmitting a Report from the Secretary of War with that of the Board of Engineers for Internal Improvement, Concerning the Proposed Chesapeake & Ohio Canal," Exec. Doc. 10, 19th Cong., 2nd sess., 1826, 26-28, <https://hdl.handle.net/2027/mdp.39015091128358>.

<sup>77</sup> Unrau, *Historic Resource Study: Chesapeake & Ohio Canal* 172.

<sup>78</sup> Unrau, 165-171; Lesley, 32.

<sup>79</sup> Lesley, 24.

<sup>80</sup> Lesley, 32.

hydraulic properties found in any rock, which accounts for much of the difference in ease and expense of construction between Louisville and Potomac canal construction cases.

By 1830, successfully identified cement rock sites formed a constellation stretching from Connecticut to Kentucky.<sup>81</sup> Cement had become a new way of conceiving the rock landscape. Americans aiming to produce modern cement simply needed to comb limestones, among the planet's most abundant rock types, for those that were dirty in the correct, iron-and-clay way. As John had stated, it was *impurities* in limestone that could make the most valuable cements. Any tinged rocks might hold the other key ingredients for hydraulicity, but they needed to be tested, which meant first kilning them and then checking the properties of the resulting powder. This guess-and-check approach to finding hydraulic cement would continue as a standard American practice for decades, even though around 1840 a second wave of transatlantic cement knowledge transfer began. Accordingly, cement science in the United States gradually shifted from a practice of only surveying rocks to one guided by a professional literature and carried out through advance testing of ingredients in industrial laboratories.

Key to this second wave of knowledge transfer was the American replication of European national departments and, specifically, the elevation of military engineers. Joseph Totten, the US Army's eleventh Chief of Engineers, took office in 1838. That same year, Totten published two works on cement sources, hydraulic properties, and uses. In a volume that included his own "Brief Observations on Common Mortars, Hydraulic Mortars and Concrete," he published a translation of a similar set of essays by French civil and military engineers.<sup>82</sup> By 1850, Totten had a notable colleague in importing European cement knowledge. Ohio-born Quincy Adams had graduated from West Point and commenced a career that included engineering coastal fortifications for the Department of War and teaching engineering principles to his successor cadets at the US Military Academy. Gillmore paid particular attention to the

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<sup>81</sup> On the relatively small natural cement works at Kensington, Connecticut from 1826, see Lesley, 31.

<sup>82</sup> J.G. Totten, *Essays on Hydraulic and Common Mortars and on Lime-burning translated from the French of Gen. Treussart, M. Petot, and M. Courtois with Brief Observations on Common Mortars, Hydraulic Mortars and Concrete* (Philadelphia: 1838).

cementing materials in those fortifications. While apparently also quite influenced by the literature from across the Atlantic, in 1864 Gillmore would become the first American to have his own writings on cement achieve widespread circulation and citation.<sup>83</sup> Importantly, these American military men were beginning to advocate the European scientific approach that involved producing hydraulic cement by an industrial recipe of proportioned mineral inputs.

The slowness with which this *make it* approach to hydraulic cement took hold in the United States is likely attributable to matters of geography. For one thing, Americans were increasingly spread out across a landscape that, though it had more transportation infrastructure every year, was not so commercially connected as Europe. That disconnection is evidenced by the fact that some individuals concocted and shared home recipes when they lacked access to industrial cements yet wanted to create barriers against water, dirt, and pests. Around 1850, one such recipe, spread via newspaper syndication, instructed homeowners to curdle some milk with vinegar before whisking the curds with egg whites and common lime to produce “a ductile paste or putty, [that] stops cracks, and is fire and water proof.”<sup>84</sup>

Another check on the *make it* approach arose because as the US empire expanded, industrialists could apply the *find it* approach to immense new swaths of the continent. Natural cement producers thereby found success in Kansas and San Francisco’s Bay Area during the 1860s, Milwaukee during the 1870s, and South Dakota in the 1880s.<sup>85</sup> The *find it* approach eventually found purchase among residents of the new State of Montana, a cement-hungry society with an economy dominated by mineral riches both

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<sup>83</sup> Q.A. Gillmore, *Practical Treatise on Limes, Hydraulic Cements, and Mortars* (New York: D. Van Nostrand, 1864). For evidence of transatlantic influence, note that even the title nearly copied that of a widely read 1850 book by an English civil engineer, which would have a fifth edition printed the following year. See George R. Burnell, *Rudimentary treatise on limes, cements, mortars, concretes, mastics, plastering, etc.*, 5<sup>th</sup> ed., (London: Virtue Brothers & Co., 1865).

<sup>84</sup> Newspaper clippings of home recipes and remedies pasted into the “Daniel Cartwright Ledger, 1848-1853,” manuscript N-2542, MHS.

<sup>85</sup> For a snapshot of nineteenth century sources in the Upper Midwest and Plains, see “A Great City in the North: What Yankton Is and What It Promises to Be,” *Omaha Daily Bee*, November 13, 1889, 6, CA; and the advertisement “Cement and Plaster” by the Great Falls Iron Works, *Neihart (MT) Herald*, September 11, 1891, CA.

real and imagined. Ernest Ringwald, W.G. Riggs, and J.C. Blanding, owners of a slate quarry in central Montana, hoped to strike gold, so to speak, with natural cement rock. In 1890, Ringwald told the Great Falls Tribune that his workers had prepared a sample to be sent east for chemical inspection, which would confirm or deny its viability as a cement rock.<sup>86</sup> The results, unreported, seem to have squelched their dreams, as no cement industry developed in the area. Ringwald and his partners, it turned out, were exhibiting a vanishing form of cement rock speculation that had entered a fatal period of decline.<sup>87</sup>

By 1890, cement had become the key to burgeoning applications of concrete, and the variability of American natural cements was drawing widespread skepticism. Unscrupulous contractors profited by billing for more hydraulic cement than they had truly used in a concrete job. Several illustrative cases occurred not far from the Ringwald site in Montana, though similar stories likely occurred elsewhere. In 1885, first a grand jury censured the Lewis and Clark County commission for their lack of oversight during construction of the courthouse in Helena, the county's seat as well as the territory's capital. Inspectors determined the contractor laying the foundation had cheated by using less a natural cement from Louisville rather than the specified recipe-based cement, and as a result the substructure was prematurely cracking.<sup>88</sup> Weeks later, the *Helena Weekly Herald* claimed that effervescence in the city water supply was occurring because the reservoir had been lined with cheap quicklime mortar rather than the more costly cement. Unlike hydraulic cement, the common lime was liable to dissolve, which it did.<sup>89</sup>

Avoiding these results of seemed to require more scientific cement production as much as it required proper oversight of public projects. Americans most concerned with making watertight and

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<sup>86</sup> "Slate Quarries," *The Semi-Weekly Tribune* (Great Falls, MT), September 13, 1890, 4, CA.

<sup>87</sup> For the decline of natural cement use due to its uneven qualities being a liability against the specific physical requirements of urban infrastructures and concrete foundations, see Lee, "Concrete Dreams," 90, 99. For an excellent summary of the fall in US natural cement production relative to portland cement production, see Lee, 72. That shift is chronicled in more detail by Lesley and, especially, by Edwin C. Eckel and Ernest F. Burchard, *Portland Cement Materials and Industry in the United States* (Washington, DC: Government Printing Office, 1913).

<sup>88</sup> "That Helena Court-House," *Semi-Weekly Miner* (Butte, MT), December 2, 1885, 3, CA. "Town Meeting: The Court House Controversy Stirred Up," *Helena Weekly Herald*, December 24, 1885, 2, CA.

<sup>89</sup> "Scarcity of Water," *Helena Weekly Herald*, January 21, 1886, 7, CA.

enduring structures had come to favor the recipe-based cements, mostly imported from Europe, over domestic natural cements, which were on the whole much more variable in their properties.<sup>90</sup> European products had simultaneously become more available through several economic factors, including the use of cement as ballast in US-bound ships.<sup>91</sup> Over the final decades of the nineteenth century, therefore, US cement producers confronted an imperative to standardize hydraulic cement products.

#### Laboratory Cement: Standardization in the United States

From the 1860s to the turn of the twentieth century, American producers gradually began to follow chemical recipes that would ensure hydraulic properties in cement. Cement scientists continued to map the lithic landscape but now to minimize the number and volume of added ingredients rather than to avoid them entirely.<sup>92</sup> The chemical language used by producers in Western Europe increasingly diffused through the American industry and aided more uniform procedures for testing ingredients prior to kilning. Cement producers also adopted the same procedures of chemical assay that other industries used to identify the percent of iron in ore or of unwanted sulfur in coal. Standard evaluation of a cement rock came to involve laboratory tests to determine its component compounds in percentages of mass, numbers which were then compared to published guideline percentages in order to determine the needed mineral supplements.

This turn in American cement science reflected the increasingly serious consequences of cement properties in everyday life. A cement that lacked the right combination of impermeability, water resistance, and longevity could generate tragedy or at least serious trouble. Fears related to unreliable cement properties became perhaps more acute as, over the same decades at the century's end, more and

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<sup>90</sup> Eckel and Burchard, *Portland Cement Materials and Industry in the United States*, 13.

<sup>91</sup> Lesley, *Portland Cement Industry*, 46-58; Lee, "Concrete Dreams," 64-70.

<sup>92</sup> See, for example, F.B. Peck, "A Map Showing the Distribution of the Rock Used in the Manufacture of Portland and Rosendale Cements in Lehigh and Northampton Counties, PA," as seen in Fred W. Uhler and Chester R. Atkinson, "The Lehigh Portland Cement Industry" (undergraduate thesis, Lafayette College, 1906), LC.

more batches of cement went into concrete structures. In concrete, bad cement could threaten the stability of a bridge or, as seen in Helena, that of a multi-story building. But the first steps in chemical standardization of American cements narrowly predated the profusion of concrete, originating in a time when faulty cements had a different kind of risk, well represented by the dissolved reservoir lining for Helena's water supply. From that water infrastructure era into the concrete age, the standardizing of cement was therefore more than a profit-seeking venture of efficiency. The task—one undertaken by individual brands and, increasingly, by the American industry as a whole—was to make cement a trusted partner that brought its density and strength to a variety of applications in the built environment. Via literature and laboratories, an increasingly well-defined community of American cement scientists strove to make cements that *all* behaved the way engineers and builders knew that *some* cements could.

No place was so important in developing American laboratory cements as was the Lehigh Valley of Pennsylvania. There, a synergy between scientific higher education and cement producers resulted in evermore detailed codification of the relationships between cement rocks and people. The glens and hills around the river called Lehigh—an anglicization of the Lenape *lechewuekink*—began hosting transplanted European industries in the mid-1700s, an era of Penn family land sales and the arrival of a Moravian community bent on self-sufficient colonies. In 1821, the recently incorporated Lehigh Coal and Navigation Company was granted effective ownership of the river. The company then began a years-long project to control the river through canal construction, a project aided significantly by Canvass White's 1826 identification of local cement rock.<sup>93</sup> By 1830, cement had made the river navigable in descent, creating a major conveyor for anthracite coal toward factories in Philadelphia and New York Harbor. In the subsequent decade, the company made the system equally navigable in ascent, allowing products of the larger cities to reach the Lehigh cities of Allentown and, only four miles downstream, Bethlehem. Two-way transit, along with the company's power to limit and direct uses of the river, encouraged

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<sup>93</sup> Martha Capwell Fox, *Geography, Geology, and Genius: How Coal and Canals Ignited the American Industrial Revolution* (Easton, PA: Canal History and Technology Press, 2019), 96.

development of heavy industry.<sup>94</sup> In 1855, completion of the regional Lehigh Valley Railroad opened another means of bulk transport.<sup>95</sup> Spurs and connected smaller railroads encouraged not only metallurgical entrepreneurs but also several cement endeavors, most clustered around what are now the towns of Egypt, Coplay, and Northampton.<sup>96</sup>

It was at Coplay that a collection of industrial experimenters first initiated American production of recipe-based, or synthetic, hydraulic cement in 1866. The group included area residents Adam Woolever, Esias Rehrig, and David O. Saylor, organized as partners of the Coplay Cement Company. Much like White and Pasley had done decades earlier, Saylor's group began by burning small batches of mineral ingredients in cookstoves.<sup>97</sup> The primary ingredient was an argillaceous (clay-rich) limestone that outcropped along the Lehigh some five miles upstream of Allentown.<sup>98</sup> The richness of clay diminished with depth toward an underlying limestone that was eighty-five to ninety-six percent pure calcium carbonate. The previous canal builders and their contemporary cement makers in seeking out the thin stratum of argillaceous limestone that by itself created a prized cement. But these three cement makers instead mixed calculated proportions of the cement rock and the purer limestone. They employed the developing field of chemical analysis to quantify and control mineral components in advance of kilning. Their synthetic product became known as a *portland*, yet another transfer of cement culture from England and a term fast becoming shorthand for reliability in the cement world.

Saylor's legacy transcended the details of this initiation and its Lehigh location. His subsequent brand recognition at Philadelphia's 1876 Centennial Exhibition, devotion to the national and international

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<sup>94</sup> "Lehigh River Legacy: The River's Past Helped Shape the Region, and Its Present Points to the Future," *The Morning Call* (Allentown, PA), October 4, 2021.

<sup>95</sup> Robert F. Archer, *A History of the Lehigh Valley Railroad* (Berkeley, CA: Howell-North Books, 1977), 31-32.

<sup>96</sup> Capwell Fox, *Geography, Geology, and Genius*, 97.

<sup>97</sup> Lesley, 18-19.

<sup>98</sup> Trenton limestone, also historically known as "Lehigh cement rock" per Uhler & Atkinson, "The Lehigh Portland Cement Industry"; Part of the Jacksonburg formation, largely defined by its cement-conductive geology, Capwell Fox, 97.

cement industry, and enduring association with developments in kiln technology can all obscure his work embeddedness in the Lehigh Valley's landscape of science and industry. That landscape had many pertinent features. The eldest were the rock formations, which held combinations of limestone and clay that in some cases, as under the thirty acres the Saylor group purchased north of Allentown, could fairly be called cement rock.<sup>99</sup> The landscape also included the riverside furnaces and rolling mills of the newly thriving Bethlehem Iron Company, a firm that overshadowed the area's Portland cement industry from the latter's beginnings. Finally, on a couple prominent hillsides along the river's final reach toward the Delaware were two postsecondary institutions. The older Lafayette College sat above the river's mouth in Easton and the newly founded Lehigh University sat above South Bethlehem's riverside iron works. Each school was freshly infused both with capital from wealthy industrialists and with faculty who promised to further develop the area's analytical chemistry practices. The Lehigh group's experiments with cement recipes occurred in a setting where industry researchers were beginning to collaborate not only with area industry but with their academic counterparts to develop language, instruments, and procedures for more precise replication of high-energy mineral fusion processes.

The same year that the Coplay Cement Company trio began collaborating, Lafayette College in nearby Easton established its new Pardee Scientific Department. The liberal arts college had promoted skills of military and civil engineering from its founding circa 1830 but had not previously offered technical degrees. That changed when Ario Pardee, the wildly successful coal speculator and director of the Lehigh Valley Railroad, got involved. In 1864, President Rev. William Cattell had solicited a donation from Pardee to avert a looming financial disaster at Lafayette set in motion by low enrollment due to the Civil War. In 1865, Pardee in turn approached the college with a plan to fund training in scientific

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<sup>99</sup> T.M. Berg, W.E. Edmunds, A.R. Geyer, A.D. Glover, D.M. Hoskins, D.B. MacLachlan, S.I. Root, W.D. Sevon, and A.A. Socolow, *Geologic Map of Pennsylvania* 2nd ed. (Pennsylvania Geological Survey, 1980).

professions that might benefit himself and his regional colleagues of heavy industry.<sup>100</sup> President Cattell's delighted acceptance initiated more than seven years of development, which began with new hires and curriculum for the Pardee Scientific Department before constructing a building to house it. A brownstone complex, five stories tall and two hundred fifty-six feet wide, would contain modern laboratories calibrated to equal the best seen in Europe and the United States at the time. Mr. Pardee covered the entire \$250,000 cost of erecting Pardee Hall and gifted another \$50,000 for equipment.<sup>101</sup> Headlining the dedication festivities on October 21, 1873, was an address by Rossiter W. Raymond, lecturer in mining geology and then-President of the American Institute of Mining Engineers.<sup>102</sup>

The literal and figurative restructuring increased the training Lafayette offered in chemical analysis, adding more industry-oriented courses to the existing curriculum focused on medicine. The new Pardee department's dean, Professor Traill Green, had taught applied chemistry for decades, but Green had come to Easton in 1836 as a recent medical school graduate and a practicing physician who was only subsequently hired by the college.<sup>103</sup> By the time Pardee made his gift, Green's medical experience was proving insufficient for postsecondary chemical instruction in the Lehigh Valley.

Green had perhaps already started accumulating textbooks more suited to industrial training. His personal library later included an 1849 translation of Heinrich Rose's *Handbuch der analytischen Chemie* (published in translation as *Practical Treatise of Analytical Chemistry*) and an 1852 translation of

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<sup>100</sup> Roger A. Egolf, "The History of Chemical Education at Lafayette College," *Bulletin for the History of Chemistry* 30, no. 1 (2005): 41-50.

<sup>101</sup> This summary of costs comes from what is apparently a press release, untitled, by Lafayette College, document WB P2 1873 in folder "RF – Pardee Hall," LC.

<sup>102</sup> Invitations to the dedication of Pardee Hall from W.C. Cattell, dated October 7, 1873, in folder "RF – Pardee Hall," LC.

<sup>103</sup> "Traill Green" in James Grant Wilson and John Fiske, eds., *Appletons' Cyclopaedia of American Biography Vol. 2, Crane – Grimshaw* (New York: D. Appleton and Company, 1887), 747. Green's trajectory from medicine toward mineral applications was not unique among analytical chemists in the mid-1800s, as evidenced by the career of J. Lawrence Smith. See Benjamin Silliman, "Memoir of John Lawrence Smith: 1818-1883," a paper read before the National Academy of Sciences, April 17, 1884, [unspecified publication of the National Academy of Sciences], 217-248, <http://nasonline.org/wp-content/uploads/2024/06/smith-j-lawrence.pdf>.

Heinrich Will's *Anleitung zur chemischen Analyse* (published in translation as *Tables for Qualitative Chemical Analysis*). After Lafayette established the new scientific department, Green acquired several more texts with similar titles like *The Commercial Hand-Book of Chemical Analysis* and *A Compendious Manual of Qualitative Chemical Analysis*, all of which were more suited to industrial chemistry than to medicine.<sup>104</sup> Though what remains of Green's library does not include books specific cement manufacture, such texts were proliferating in these years. The literature built on the aforementioned work of Totten and Gillmore, and it similarly consisted of both translations and original works in English.<sup>105</sup>

A chemistry department was among the first units of Lehigh University, which opened in 1865 with a nest egg from the canal boat builder turned railroad investor Asa Packer. His initial bequest included 60 acres of land and \$500,000 that funded several new buildings on the hillside south of Bethlehem and obviated Lehigh's need to charge tuition.<sup>106</sup> In 1871, the university added William Henry Chandler to its cadre of faculty in the industrial sciences. When hired, Chandler was still completing a PhD at Hamilton College but had already begun publishing a journal, *The American Chemist*, with his older brother, Charles, a founder of Columbia University's School of Mines and the appointed chemist on

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<sup>104</sup> The exact relevant works that Traill Green held, and then donated to the Lafayette College where they remain in the Special Collections & College Archives, are: Frank Clowes, *An Elementary Treatise on Practical Chemistry and Qualitative Inorganic Analysis*, 2<sup>nd</sup> English ed. (Philadelphia: Henry C. Lea, 1877); Charles W. Eliot and Frank H. Storer, *A Compendious Manual of Qualitative* (New York: D. Van Nostrand, 1869); A. Normandy, *The Commercial Hand-Book of Chemical Analysis*, 2<sup>nd</sup> ed. (London: Lockwood & Co., 1865); Maurice Perkins, *An Elementary Manual of Qualitative Chemical Analyses* (New York: John Wiley & Son, 1867); H. Rose, *Practical Treatise of Chemical Analysis*, trans. from the French and from the fourth German ed., with notes and additions, by A. Normandy (London: William Tegg and Co., 1849); Heinrich Will, *Tables for Qualitative Chemical Analysis*, 2<sup>nd</sup> ed., trans. William L. Faber (Philadelphia: A. Hart, 1852).

<sup>105</sup> For an example of original and/or translated works by British civil engineers, see W.F. Reid, *A Translation of M.A. Lipowitz's Work Describing a New Method Adopted in Germany of Manufacturing that [portland] Cement*, published as a separately paginated appendix to Henry Reid, *A Practical Treatise on the Manufacture of Portland Cement* (London: E. & F.N. Spon, 1868). For an American civil engineer trained at the École Centrale des Arts et Manufactures in Paris and writing on the Rhône Valley cement industry, see Leonard F. Beckwith, *Report on the Hydraulic Lime of Teil* (New York: D. Van Nostrand, 1873).

<sup>106</sup> "Asa Packer," in *The Encyclopædia Britannica*, 11<sup>th</sup> ed., vol. 20 (University of Cambridge Press, 1911), 441-442.

New York City's Metropolitan Board of Health.<sup>107</sup> *American Chemist* was the Chandler brothers' enterprising response when William Crookes, owner of the London publication *The Chemical News*, told them to cease and desist from tweaking that periodical and reprinting an edition out of New York.<sup>108</sup> Their alternative quickly facilitated a national chemist community, such that Chandler's hiring meant Lehigh had just brought an astoundingly well connected professional to the locus of American portland cement production.

William Chandler's proclivity for establishing and leading professional community ensured the Lehigh Valley continued as an unmatched incubator for cement knowledge in the United States. In his first semester, Chandler founded The Chemical Society of the Lehigh University, a group for students.<sup>109</sup> At the inaugural end-of-year celebration, student members heard from guest speaker Benjamin Silliman, Jr., the esteemed Yale chemistry professor whose 1855 report on the potential to distill Western Pennsylvania rock oil into illuminating fuel had helped launch the American petroleum industry.<sup>110</sup> In addition to inviting eminent figures to South Bethlehem, Chandler exposed the group's students to chemical literature from not only his own journal, but any publication that offered the latest observations and theories on topics including alumina, iron, and, water, Chandler's specialty.<sup>111</sup>

The professor's connections soon included his colleagues at Lafayette as well as employees of local industry. These relationships later became more formal when, in 1894, Chandler became first president of the Lehigh Valley Section of the American Chemical Society (ACS), a group consisting

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<sup>107</sup> Mary Ellen Bowden and John Kenly Smith, *American Chemical Enterprise: A Perspective on 100 years of Innovation to Commemorate the Centennial of the Society of Chemical Industry (American Section)* (Philadelphia: Chemical Heritage Foundation, 1994), 82.

<sup>108</sup> William H. Brock, "The Chemical News, 1859-1932," *Bulletin for the History of Chemistry* 12 (1992): 32; "Lehigh Connections: The American Chemist," in *The Royal and the Origins of Scientific Communication*, an exhibit by the Lehigh University Special Collections, [exhibits.lib.lehigh.edu/exhibits/show/royalsociety/lc/tac](http://exhibits.lib.lehigh.edu/exhibits/show/royalsociety/lc/tac), accessed January 22, 2025.

<sup>109</sup> Letter from Richard N. Rhoda [professor of chemistry at Lehigh University] to James D. Mack, librarian, June 25, 1952, manuscript L 378 E C5175, LU.

<sup>110</sup> Gerald T. White, "The Silliman Controversy," *Huntington Library Quarterly* 30, no. 1 (1966): 36.

<sup>111</sup> Notebook 2, "General," Archives of Chemical Society of Lehigh University (SC MS 0074), Box 1, LU.

mostly but not exclusively of professors who would meet monthly, alternating between Bethlehem and Easton.<sup>112</sup> Among the three papers read at the first regular meeting that April were “The Constitution of Portland Cement,” delivered by a 22-year-old cement mill worker named George Scholl as a much more specific complement to Chandler’s offering that day, which was titled “The Demand for Technical Chemists.”<sup>113</sup> At the next meeting, the laborer Scholl followed up with a paper on testing portland cement.<sup>114</sup>

This vigorous industrial chemistry community in the Lehigh Valley helped cement science blossom among college students. This was evident in the senior projects completed at both Lehigh and Lafayette. In 1892, Lehigh engineering major Frederick Coleman submitted “A Thesis on Cement Testing and a Description of the Manufacture of Portland Cement.” Coleman began with a geological explanation of cement rock, describing how a marine environment can transition over time from a place of calm water where silt accumulates to one dominated by tiny creatures depositing calcium carbonate. That gradual change in deposited material could leave behind a sequence of rock that graded from clay into purer and purer limestone. This was the sequence seen in cement rock quarries of the Lehigh vicinity, which Coleman described and compared to other formations throughout central Appalachia.<sup>115</sup> Coleman, however, covered much more than this basic geological interpretation. By the end of the thesis, he had gotten into the work of German chemist Wilhelm Michaelis on the subject of chemical analysis and theories of how exactly cement hardened.<sup>116</sup>

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<sup>112</sup> “Feb. 15, 1894,” *Record Book No. 1 (1894-1923)*, American Chemical Society, Lehigh Valley Section Record Books, 1894-1943 (SC MS 0130), LU.

<sup>113</sup> “George Scholl,” in U.S. Bureau of the Census, *Twelfth Census of the United States, 1900*, Allen Township, Northampton County, Pennsylvania, Enumeration District 94, Sheet 26A, Line 13, accessed via Ancestry Library Edition; “April 5, 1894,” *Record Book No. 1 (1894-1923)*, SC MS 0130, LU.

<sup>114</sup> “May 3, 1894,” *Record Book No. 1 (1894-1923)*, SC MS 0130, LU.

<sup>115</sup> F.A. Coleman, “A Thesis on Cement Testing and a Description of the Manufacture of Portland Cement,” (undergraduate thesis, Lehigh University, 1892), 4, 9, LU.

<sup>116</sup> Coleman, “A Thesis on Cement Testing...,” 17, 18.

Despite writing eighty-four substantive pages on cement, Coleman had not come close to exhausting the topic as far as scholars in the Lehigh Valley were concerned. In 1895, Lafayette's typical list of engineering theses on steel, electricity, railroads, and coal mining was interrupted by titles like "Porosity of Cement," "Strength of Concrete," and "The Magnesian Limestone in Easton and Vicinity: Structural and Chemical Geology."<sup>117</sup> Over the following decade, many Lafayette students chose cement as the subject of their capstone project. By 1930, Lehigh and Lafayette students would submit three dozen cement-focused theses.<sup>118</sup>

Meanwhile, in 1897, Lafayette hired Frederick Burritt Peck, an expert in cement rock who, in addition to training college students on the industry's geology, quickly began contributing to Pennsylvania's state surveys of economic geology.<sup>119</sup> A report Peck later generated for the Lehigh Portland Cement Company, after their 1914 acquisition of a limestone business in Western Pennsylvania, demonstrates how his approach blended geology and industrial chemistry (Fig. 1.2). The report began with a sketch that depicted the rock layers beneath New Castle, Pennsylvania. The sketch used typical field geology practice for a stratigraphic column with approximate thicknesses and markings that gave a rough sense of layers' compositional differences. However, each layer merged into a row in a table that

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<sup>117</sup> "60th Annual Commencement, Reading and Defence of Theses of the Class of '95, in the Pardee School of Science, Lafayette College," a bulletin in folder "RF – Pardee Scientific Department-announcements, 1896-1944," LC.

<sup>118</sup> This is possibly a severe underestimate of theses on cement and/or concrete, since it counts only those archived at the institutions. For instance, at Lehigh there is only one qualifying thesis archived from 1919, but the student newspaper announced that two other seniors in civil engineering were writing on the subject. See, "C.E. Theses," *Lehigh Brown and White* [Bethlehem, PA], March 25, 1919, 1, viewed at The Brown and White, An Archive of Lehigh University's Student Newspaper, 1894-, <https://bwarchive.lib.lehigh.edu/>.

<sup>119</sup> The Commonwealth of Pennsylvania, *Topographic and Geologic Survey of Pennsylvania, Report No. 5, 1899-1906* (Harrisburg Publishing Co., 1906), 27-28. Around this time, state surveys focused on cross-pollinating Pennsylvania's industrial zones by standardizing geologic knowledge across them. The goal seemed to be maximizing efficient use of all the state's rocks toward existing industries, which included bringing the Western district up to speed with the Lehigh's cement production. See, for example, R.W. [Ralph Walter] Stone, "Limestone in Western Pennsylvania," in The Pennsylvania Topographic and Geological Survey Commission, *Biennial Report of the Topographic and Geologic Survey of Pennsylvania, 1906-1908* (Harrisburg Publishing Co., 1908), 326-334.

displayed the results of laboratory chemistry, translating the rocks beneath New Castle into their characteristics as a future cement ingredient that workers would mix in the correct proportions of calcium carbonate to clay and iron minerals.<sup>120</sup>

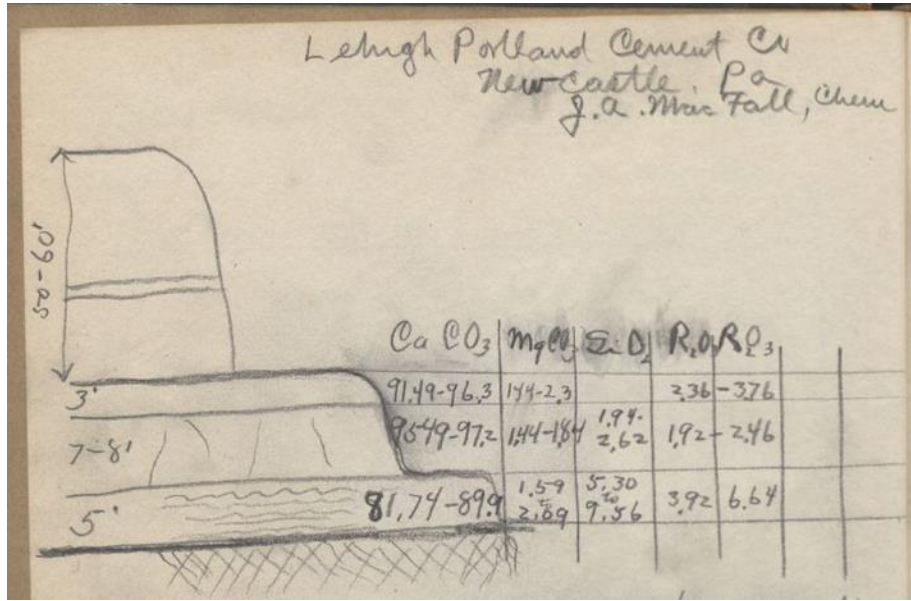


Figure 1.2. Stratigraphic column and table of associated mineral compositions, by Frederick Burritt Peck in a report to the Lehigh Portland Cement Company on limestones near New Castle, Pennsylvania. Courtesy of Lehigh University Special Collections.

Cement remained a regular topic of discussion for the Lehigh region’s ACS chapter and one that would occasionally dominate meetings over the subsequent decade. For instance, all the papers presented at multiple meetings in the fall of 1903 dealt with cement. One characterized local geology for its cement potential, a second analyzed the raw material inputs, a third covered fueling the continuous rotary kilns then standard in new plants, and a fourth addressed testing the strength of finished products. The chapter’s secretary, a Lehigh graduate student named Walter Landis, recorded that many professionals from the local industry engaged in a long discussion following the papers. The group did not convene again until the next June, when fifty attendees again spent much of the meeting hearing about cement.<sup>121</sup>

<sup>120</sup> F.B. Peck, *Vanport Limestone in Lawrence Co., PA.*, SC MS 0190, LU.

<sup>121</sup> *Record Book No.1 (1894-1923)*, 29, 37-39, SC MS 0130, LU.

Chandler led Lehigh's chemistry department for thirty-five years, from 1871 to 1906. His network of chemists had helped make the region an international center for cement knowledge in addition to being the nation's unparalleled center of manufacture.<sup>122</sup> During Chandler's tenure, the local cement industry expanded from the handful of small concerns around Coplay to thirty full-fledged mills owned by twenty-one separate firms (Figs. 1.3 & 1.4).<sup>123</sup> Each mill meant at least one large hole in the ground, over time generating an odd swath of landscape where gently rolling farm fields suddenly gave way to flat-bottomed pits below gray cliffs of impure limestone. In each pit, workers employed the powerful chemical product nitroglycerine, or dynamite, to blast apart thick beds of cement rock. Others brought the resulting rock chunks to the factory's lab for analysis and subsequent transformation into a different chemical product that was powerful in its own right.<sup>124</sup> Cement for construction contrasted with dynamite for destruction, but both were avenues of blended social and environmental power that had been opened by nineteenth-century industrial chemists.<sup>125</sup>

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<sup>122</sup> For a different perspective on the development of the Lehigh region's cement industry and what it meant to national projects such as channelization of the Mississippi River's mouth, see Capwell Fox, *Geography, Geology, and Genius*, 96-99.

<sup>123</sup> Uhler & Atkinson, "The Lehigh Portland Cement Industry."

<sup>124</sup> For the use of explosive powder by cement quarry laborers in the Lehigh region, see Pivo, "Gospel of Concrete," 54-59.

<sup>125</sup> This use of powerful as at once an environmental and a non-metaphorical social descriptor is again based on Russell, Allison, Finger, Brown, Balogh, and Carlson, "The Nature of Power: Synthesizing the History of Technology and Environmental History."

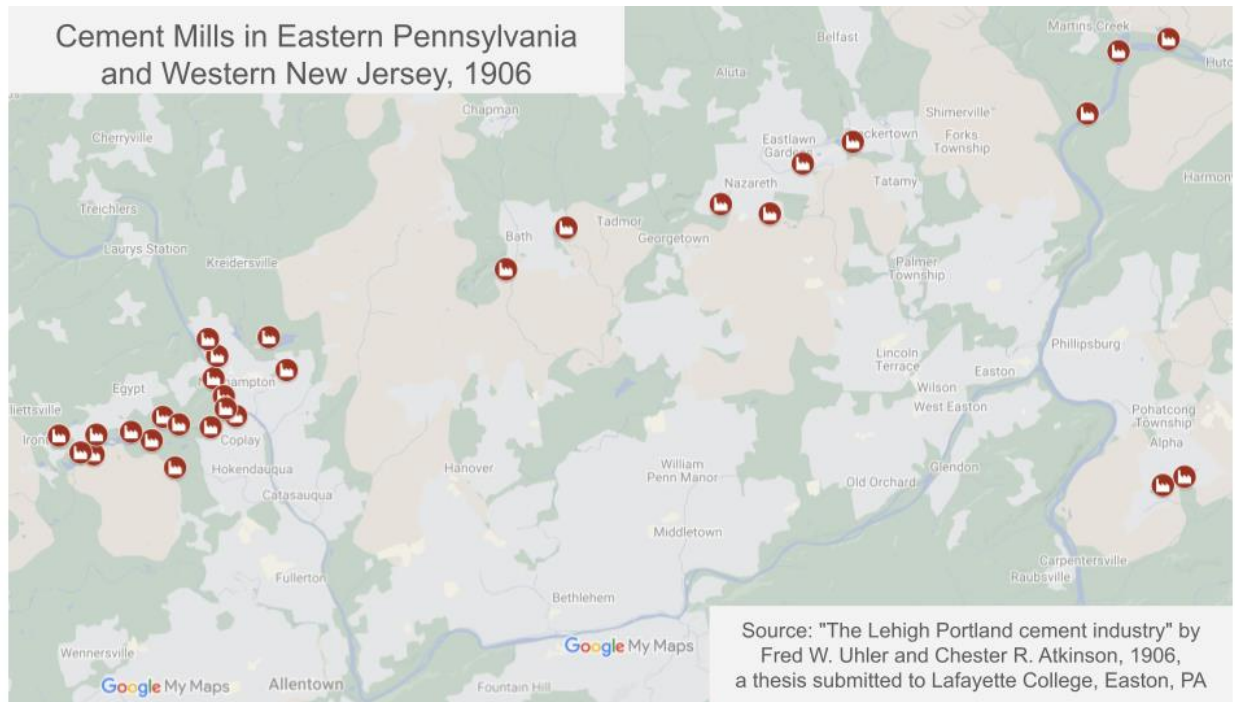


Figure 1.3. Approximate locations of the thirty Lehigh area cement plants named in a 1906 thesis submitted to Lafayette's Department of Mining Engineering by students Fred Uhler and Chester Atkinson. Map data ©2025 Google.



Figure 1.4. Uhler and Atkinson’s thesis also included a copy of this map that their advisor, the geologist F.B. Peck, likely produced for the State of Pennsylvania. Comparison with Figure 1.3 reveals how closely the cement plants followed a regional layer of rock now known as the Jacksonburg Formation. Peck calls this “the rock used in the manufacture of Portland and Rosendale cements,” the latter being a common synonym for natural cement, derived from the Hudson Valley location that produced so much of that material into the late 1800s. The three major Lehigh Valley cities are visible, West to East: Allentown; Bethlehem, with Lehigh University in South Bethlehem; and Easton, with Lafayette College. Image courtesy of Special Collections & College Archives of Lafayette College.

### Microscopy: Looking for Cohesion Beyond the Plainly Visible

American cement scientists continued to read publications from their European counterparts, which informed another development around the turn of the century. This was a turn toward microscopy that brought a literally closer look at cement’s density. By then, density was a topic of interest for structural engineers worried about the strength of concrete even as density remained synonymous with

waterproofness in many cement applications. The turn toward microscopy and its origins were epitomized by Joseph L. Mack's 1905 translation of French chemical engineer Henri Le Chatelier's *Recherches Expérimentales sur la Constitution des Mortiers Hydrauliques*.<sup>126</sup> Mack, recent recipient of a bachelor's in chemistry at the University of Pennsylvania, was not introducing the Anglophone world to Le Chatelier. Instead, he sought to increase access to a text that had become foundational in the nearly two decades since its publication as Le Chatelier's doctoral thesis.<sup>127</sup> Soon after publishing the translation, Mack began work at the Nazareth Cement Company. He joined the Lehigh Valley ACS and was a neighbor of fellow member Richard K. Meade, an author of many journal articles on cement chemistry who was then completing his own book-length work, *Portland Cement: Its Composition, Raw Materials, Manufacture, Testing and Analysis*.<sup>128</sup> While Meade's project largely summarized American cement knowledge to-date, Mack's translation opened a new chapter in which scientists aimed to fine-tune cement properties with help from microscopes.

Mack's translation of Le Chatelier was more than simply another point on a decades-long timeline of works by European authors informing the instruments, language, and goals of industrial scientists in the United States. If its transatlantic trajectory was conventional, the widespread influence of Le Chatelier's *Recherches* still indicated something novel. Le Chatelier had not been satisfied with cement production's scientific bookends of chemically analyzing rock before its input and then physically testing it post-manufacture. He instead sought to understand how cement operated throughout the

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<sup>126</sup> Henri Le Chatelier, *Experimental Researches on the Constitution of Hydraulic Mortars*, trans. Joseph Lathrop Mack (New York: McGraw, 1905).

<sup>127</sup> "Translator's Preface," 1905 Mack translation of Le Chatelier, v. Later examples that make Chatelier's influence unmistakable include O.H. Spillman, "A Study of the Cement Gun and Tests of Gunitite Slabs" (undergraduate thesis, Lehigh University, 1919), 61, LU; Eduardo Mena, "Preliminary Report on the Erection and Operation of a Portland Cement Plant in Ecuador" (MA thesis, Lafayette College, 1921), 5, 8, LC; W.C. Hanson, L.T. Brownmiller, and R.H. Bogue, "Studies on the System Calcium Oxide-Alumina-Ferric Oxide," in "Paper - Portland Cement Association Fellowship at the National Bureau of Standards," no. 1 (1926), LC.

<sup>128</sup> Richard K. Meade, "Portland Cement," *Journal of the American Chemical Society* 29, no. 3 (1907), 404-406. On Mack's identity, see "Met at Nazareth," *The Allentown (PA) Democrat*, April 1, 1908, 4, CA; "List of Members - May 27, 1907," *Record Book No.1 (1894-1923)*, 54, SC MS 0130, LU.

production process, and at a scale invisible to unassisted eyes. In the 1880s, when Chatelier had conducted and written on his *Recherches*, watching a series of mineral transformations suddenly seemed possible.

The field of mineral microscopy had emerged in the 1830s from attempts by the British paleobotanists William Nicol and Henry Witham to see details in fossil wood by gluing a piece to glass and shaving or grinding it down toward transparency, creating what is still today called a *thin section*. Their publication of the technique led to developments for similar studies of shells as well as for dentistry and, thereafter, use of more robust grinding technologies for application to harder minerals.<sup>129</sup> Surely most important for Le Chatelier were contributions to mineral microscopy made by the amateur microscopist Henry Clifton Sorby, who in the 1860s adapted the techniques to inspect products of the steel industry around his Sheffield, UK, home. Sorby subsequently became a promoter of microscopy at the intersection of geology and industry.<sup>130</sup> No doubt this informed Le Chatelier's experimental plan, which involved making thin sections at multiple points in the kilning. He thereby characterized how mineral hardening proceeded in hydraulic cement, to determine what chemical compositions resulted in the most thoroughly mineralized mortars, and, ultimately, to generate knowledge that would allow effective and consistent creation of denser matrixes in structures.<sup>131</sup> *Recherches* showed that a cement with superlative functionality was not the inevitable result of a single prized chemical formula but rather one stage in a dynamic system that could be observed by the quickly evolving science of mineral microscopy.

In emphasizing the microscopic level of cement cohesion, Le Chatelier positioned his own work on hydraulic cements as descendant from national forebearers beginning with the renowned Lavoisier.

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<sup>129</sup> Howard J. Falcon-Lang and Dawn M. Digrius, "Palaeobotany under the Microscope: History of the Invention and Widespread Adoption of the Petrographic Thin Section Technique," *Quekett Journal of Microscopy* 42 (2014): 253-280.

<sup>130</sup> H.C. Sorby, "Preparation of Transparent Sections of Rocks and Minerals," a paper read before the Sheffield Microscopical Society, March 3, 1882, as printed in *The Northern Microscopist* 17 (May 1882): 101-106, 133-140.

<sup>131</sup> Le Chatelier, *Experimental Researches*, trans. Mack, 73-87.

*Recherches* quoted the well-known French chemist's 1765 claim that the gypsum mortars then commonly used in and around Paris worked via a "rapid and irregular crystallization" that produced small crystals so intimately entangled as to produce an exceptionally hard mass. While honoring Lavoisier and appreciating this insight on masonry minerals, Le Chatelier determined that an update was due. Microscopy and photography proved Lavoisier's theory that the hardness of a cement ensued from the intimacy of its components (Fig. 1.5). The nearer the entanglement, or the less empty pore space, the harder the mortar mass became. It also brought Lavoisier's crystallization theory to bear on a new era of cements, in which sufficient density translated to a bridge withstanding the fleeting compression of a freight train or a foundation wall preventing permeation by water and gases in the earth.

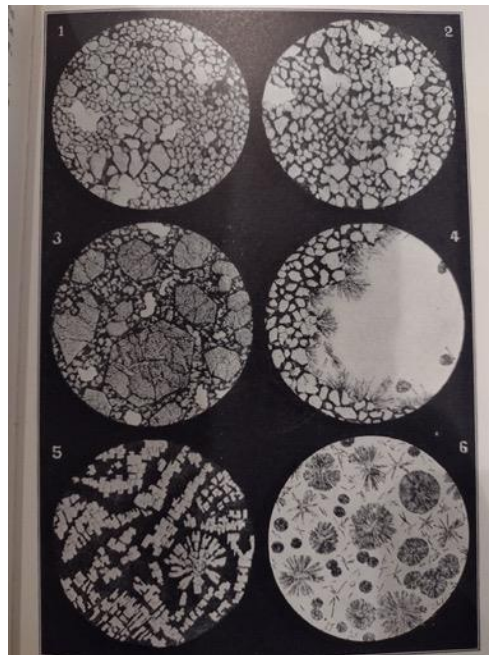


Figure 1.5. Microscopy photographs from Henri Le Chatelier, *Experimental Researches on the Constitution of Hydraulic Mortars*, trans. Joseph L. Mack (1905).

Deployment of microscopy throughout cement production resonated with contemporary principles of industrial efficiency then buzzing around the industrial world. As Frederick Winslow Taylor would make plain in his famous distillation of scientific management, these principles primarily aimed to

precisely manage factory laborers by analyzing data of time and output.<sup>132</sup> But in the case of cement production, microscopy was also part of a broader effort to more minutely analyze and manage the cement itself. Beginning in the 1870s, engineers adopted, developed, and promoted new milling equipment that pulverized rocks at multiple points during production. This was in fact critical to the portland cement process.<sup>133</sup> First, argillaceous limestone and any other ingredients needed to be ground very finely before they were fed into a kiln. This would ensure the entire mass reached the desired temperature of around 1500°C, at which the minerals would microscopically fuse.<sup>134</sup> This fusion always produced macroscopic clumping in the resulting material, which is called *clinker*. Each visible lump in clinker meant that some amount of cement within it would not fully react with water. That cement would therefore not help fill the pores within bricks or, in a concrete mixture, between pebbles and grains of sand.

As early as 1877, engineers referred to a standard for cement fineness by which eighty-five per cent of the ground clinker material was to pass through a sieve of 200 mesh openings in each square inch.<sup>135</sup> Articulating this standard, let alone applying to all cement production, required many sieves. These pans or cups with woven-wire cloth over one end, each made to a standard mesh size numbered as are thread counts for bedsheets, became vital instruments not only for cement producers but for users as

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<sup>132</sup> On management interests among engineers in the 1880s, see Horace Bookwalter Drury, *Scientific Management: A History and Criticism*, 2<sup>nd</sup> rev. ed. (New York: Columbia University, 1918), 31-33. For more history of scientific management, David A. Hounshell, *From the American System to Mass Production, 1800-1932: The Development of Manufacturing Technology in the United States* (The Johns Hopkins University Press, 1984), 249-253; Frederick Winslow Taylor, *The Principles of Scientific Management* (Harper & Brothers Publishers, 1911).

<sup>133</sup> For more on the history of grinding cement and its relation to similar developments in other industrial processing, from grain to metal ores, see A. J. Lynch, and Chester A. Rowland, *The History of Grinding* (Society for Mining, Metallurgy, and Exploration, Inc., 2005), 96-105. On the shift from steam-powered millstones to coal-powered ball mills and its role in bringing portland cement production to profitable scales, see Lee, 68-74.

<sup>134</sup> These imperatives are described with particular concision in Howard J. Force, "Method of Treating Portland and Similar Cement," US Patent 1,085,977, filed September 13, 1912, and issued February 3, 1914.

<sup>135</sup> William W. Maclay, C.E., Paper CLII: "Notes and Experiments on the Use and Testing of Portland Cement," *Transactions of the American Society for Civil Engineers* 6, no. 1 (1878): 323-324.

well. As construction professionals eschewed the imprecise practice of visually inspecting each bag of cement delivered to a construction site, they nonetheless agreed that one subject of those dated examinations, cement's fineness, remained highly important.<sup>136</sup> The visual inspections were thus replaced with sieves. By 1890, engineers found that cements regularly met their standards for fineness, which as one put it required "an impalpable powder" so that each molecule could react with water to form paste that coated every micrometer of surface on the sand and gravel, pebbles, or broken stone—or *aggregates*—in concrete.<sup>137</sup> In the subsequent years, standards for impalpability only crept higher, such that in the early twentieth century the cement authority Spencer Newberry would state that at least ninety-five percent of the powder should pass through a 200 mesh sieve.<sup>138</sup>

These standards for invisibly fine cement in cement construction of course fed back into the engineering of cement plants, motivating adoption of ever more powerful and thorough grinding mills.<sup>139</sup> The fineness imperative stood the test of time because it helped concrete to also stand the test of time. Microscopically managing production helped cements contribute to less porous and less crack-prone results. This level of detail made cement a precision building material and echoed the careful interlocking designs of Smeaton a century and a half earlier. It was also yet another dimension of the deepening and widening body of cement-related standards.

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<sup>136</sup> Henry Faija, *Portland Cement for Users*, 3<sup>rd</sup> ed. (London: Crosby Lockwood and Son, 1890), 6.

<sup>137</sup> Faija, "Preface to Third Edition," in *Portland Cement for Users*.

<sup>138</sup> Spencer B. Newberry, "Process of Making Waterproofing for Concrete and the Product Thereby Produced," US Patent 1,471,410, filed July 2, 1921, and issued October 23, 1923. See also, "Test for Fineness of Grinding" in A.H. Heath, *A Manual on Lime and Cement, Their Treatment and Use in Construction* (London: E. & F.N. Spon, 1893), 90-93.

<sup>139</sup> For examples, see the mill technologies described in Melvin B. Church, "Grinding-Mill," US Patent 259,495, filed December 15, 1881, and issued June 13, 1882, and the later precise stipulations for "prolonged agitation in a pug-mill" or, somewhat preferably, "use of a swing-hammer or impact pulverizer" in Newberry, "Process of Making Waterproofing for Concrete."

### Testing and Mixing to Avoid Voids

Cement science had grown into a large field encompassing the work of published academics and a host of industrial professionals contributing to knowledge in the specific factory settings where people collaborated with heat and minerals to produce cement. Another wing of cement science was practiced by users, whether meaning civil engineers or construction contractors, who in the concrete age adopted increasingly technical means of assessing cement for cohesion, strength, and expansion or contraction before committing to build within any given batch. For instance, by the 1880s the old practices of visually inspecting a powder's color and fineness or measuring the weight of a bushel were being replaced by making hand-sized test "pats" of cement and water, letting them harden, and then stressing them to point of failure.<sup>140</sup> Again, the primary motivation was avoiding casualties and substantial costs that might ensue from a concrete structure's failure. That risk grew all the more serious as reinforcement with iron rods allowed for concrete walls, roofs, and bridge decks.<sup>141</sup>

Swelling responsibility led to an array of new instruments and processes for testing cement or concrete as well as various standard graphs against which to measure results.<sup>142</sup> Through the 1890s, those technologies were the subject of US engineers' discussions, especially in meetings of or via materials published by the American Society of Civil Engineers (ASCE). Members articulated the best practices cement use, outlining procedures for testing cements on site as well as for mixing and applying concrete so as to maximize strength and longevity. Alongside and sometimes within those ASCE discussions, cement industry professionals began developing consensus on standard proportioning, kilning, and grinding of cement ingredients.<sup>143</sup> The responsibility around good concrete became so immense a

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<sup>140</sup> Faija, *Portland Cement for Users*, 3.

<sup>141</sup> In this arena, failures of concrete were also liable to be leveraged by direct competitors including the brick-building industry. See Slaton, *Reinforced Concrete and the Modernization of American Building, 1900-1930*, 122.

<sup>142</sup> For an overview of cement testing and charting as it stood in the 1890s, see Chapter VII of Cummings, *American Cements*, 96-209.

<sup>143</sup> Lesley, *Portland Cement Industry*, 144.

professional arena that by the turn of the century cement standards and concrete standards were becoming separate divisions. In 1902, the American Society for Testing Materials (ASTM) held its first meeting. ASTM effectively replaced the American Section of the International Association for Testing Materials. The new organization also took charge of cement standardization, which allowed the ASCE's cement committee to focus on construction testing procedures rather than defining acceptable material.<sup>144</sup>

Industry historian Robert W. Lesley, writing in the 1920s, stated that ASTM cement specifications, complemented by the work of cement committees within several smaller organizations, had forced American producers to generate cement “which would meet every requirement of the most critical buyer for every type of engineering work.” This standard cement baked into one recipe as many desired qualities of modern cements as possible, including hydraulic properties and relative impermeability. That caliber had likely been achieved at most cement plants within the first decade of the twentieth century, though American portland producers still then contended with lingering preference for imports. In 1907, Owl Cement in La Salle, Illinois advertised itself as a “German-American Portland Cement Works,” seemingly a nod to those who still thought northern Europe's products were best.<sup>145</sup> Most within the industry and among professional engineers knew better. The disreputable US outfits were expiring if not already ceased, and cement scientists were ensuring uniformity across products at La Salle as much as they were at Stettin.<sup>146</sup>

As civil engineers and builders insisted on higher quality cement from American producers, they also sought to refine their own practices of mixing cement with aggregates. Even for larger projects, the act of combining cement with the other ingredients was, at the turn of the century, often accomplished as it is now for backyard projects: stirring it all together in a wheelbarrow with a shovel before adding water to create a gloppy paste. Many cement users noted the opportunity for improved mixing equipment

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<sup>144</sup> Lesley, 144.

<sup>145</sup> Richard L. Humphrey, ed., *National Association of Cement Users: Proceedings of the Third Annual Convention* (National Association of Cement Users, 1907), 366.

<sup>146</sup> Lesley, 146.

techniques and equipment that might more thoroughly mix cement and minimize the number of cavities of any size that would exist within the hardened concrete structure. Engineers and tinkerers alike turned their focus to the size of aggregates, the proportioning of various sizes to one another and to cement, and the equipment used to combine all those solid components with water. Improvements in these areas promised to complement cement's hydraulic chemistry in realizing a denser and more durable concrete. Thoroughly mixing the aggregates, to fit them together in the manner of Tetris pieces, in the presence of wetted cement, to better coat each rock bit and make the entire mixture as compact as possible, was important not only for the strength of concrete but also for the preservation of the steel reinforcing bars that increasingly lay within and supported concrete structures. Any voids in concrete would increase water's ability to move through the structure, rust the bars, and, because rusting is a process of expansion, begin cracking the concrete from the inside.

With proper practices, it seemed, the aggregate materials of concrete would not so greatly compromise the impermeability of cement. Theorizing the most thorough compaction of concrete constituents had cropped up in the early 1870s but became a much wider topic of discussion at the century's end.<sup>147</sup> In the 1890s, many engineers hailed new mixing machine technologies for their help toward void eradication.<sup>148</sup> The practice of mixing cement powder with sand and gravel in a wheelbarrow fell out of favor, replaced by new apparatuses that contained the mixing within a steel drum cranked about a horizontal axle. Besides being more comfortable for the person doing the mixing, considering the dust

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<sup>147</sup> See for example, James L. Rowland, "Improvement in Hardening Artificial-Stone Walls, Concrete, etc.," US Patent 128,980, filed July 16, 1872, in which Rowland emphasizes size of components, "...materials should be very finely pulverized. ...which particles can be most fitly and compactly compressed into a mechanical arrangement of the greatest strength and permanency. By thus reducing the materials they will have a more extended contact, and afford more connecting surfaces, the material which is formed in a natural fine state with the atoms dulled and rounded by attrition." Rowland would "Procure the best hydraulic cement" which he re-sieved himself and then pulverized with rollers before passing it "through bolting-cloth of exceedingly fine texture, so as to exclude all that is not in a perfectly-powdered condition."

<sup>148</sup> "Mortar Mixing by Hand" and "Mortar Mixing by Machine," in Heath, *A Manual on Lime and Cement*, 125-129.

that kicked up when churning cement powder, the new devices were understood to promote a more intimate integration of concrete's constituents. At the turn of the century, cube-shaped mixing containers gained popularity on the theory that the shifting angles during revolutions induced the most thorough possible homogenization. Lehigh student Milton Cory, in his 1904 thesis on how cement and concrete were being used in mines, illustrated a "home-made" cube cement mixer that mining engineers might assemble at their work sites (Fig. 1.6).<sup>149</sup>

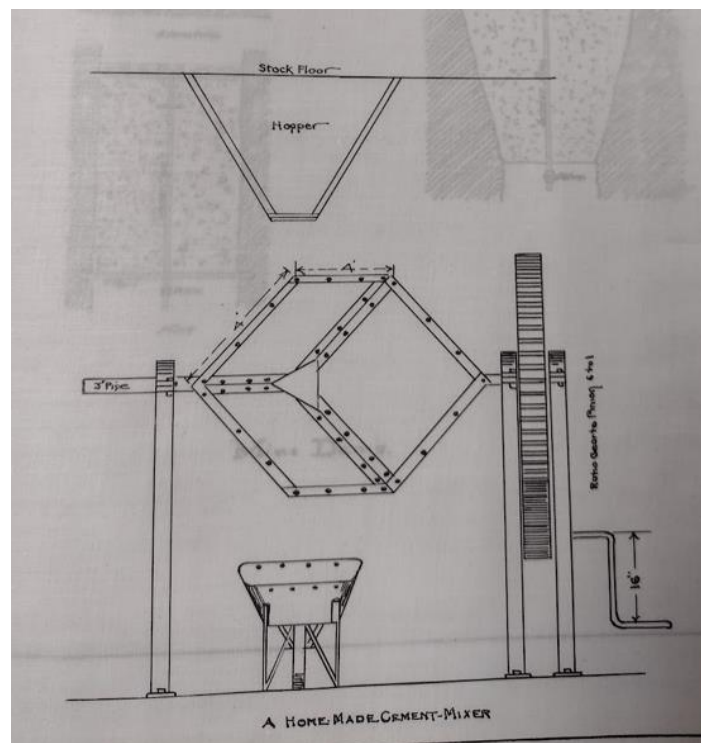


Figure 1.6. Rendering of a hand-operated cement mixer included in the 1904 thesis of Milton Cory submitted to Lehigh University. Such cubic metal boxes on a shaft had become standard cement mixing equipment.

Mass-produced mixers became available around the same time, and when the National Association of Cement Users first convened in 1905, advertisements for mixers immediately became a

<sup>149</sup> M.B. Cory, "A Review of the Uses of Cement and Concrete in Mining Operations" (undergraduate thesis, Lehigh University, 1904), 39, LU.

mainstay of their conference publications.<sup>150</sup> By then, instructions for the best proportion of fine aggregates to coarser aggregates to cement and water, the ratio that would produce a properly dense concrete, had also become codified in handbooks and other publications for contractors. An oft-repeated procedure in handbooks instructed those building with concrete to use a large, watertight container of known volume for determining a proper ratio of concrete constituents on site. The procedure's principle was simple: use water to get measurements of the pore volume that remained after the container had first been filled with the gravel on hand and then the sand to be used had been poured and shaken into the voids between gravel. Whatever space remained was the volume of water plus cement to be used, yielding a proportion that theoretically could eliminate voids in the finished concrete.<sup>151</sup> Yet other texts claimed to have reduced that tedious void-minimizing procedure to a set of tables and mathematical adjustments that accounted for different grain sizes of sand and for contingencies when proportioning by either volume or weight.<sup>152</sup>

After 1907, some construction engineers began adapting a new delivery system, reportedly first used for plaster of Paris in taxidermy at the Field Museum, into a technology that would mix concrete as it was being applied.<sup>153</sup> The so-called cement gun sprayed concrete mix from a hose nozzle, allowing the user to coat objects and surfaces with a concrete distinctive enough to earn its own name: gunite or, later, shotcrete. A common goal of sprayed-on concrete was to create an impervious coating. Sprayed around steel beams, a gunite barrier could prevent rust for decades.<sup>154</sup> Sprayed within an irrigation canal, a gunite

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<sup>150</sup> Humphrey, *National Association of Cement Users: Proceedings of the Third Annual Convention*, 341-384.

<sup>151</sup> See, for example, P.B. Beery, *Portland Cement Side-walk Construction: Based Upon the Experience of Many Successful Contractors*, 2<sup>nd</sup> ed. (Chicago: Cement and Engineering News, 1904), 26-27.

<sup>152</sup> Several examples are found in Charles Carroll Brown, ed., *A Hand-book for Cement Users*, 3<sup>rd</sup> rev. ed. (Indianapolis: Municipal Engineering Company, 1905), 123, 131, 133.

<sup>153</sup> Spillman, "A Study of the Cement Gun and Tests of Gunite Slabs," 8.

<sup>154</sup> Of course, any cracking created a grave liability, whereby cement might trap any water that entered and actually increase the rate of rusting. Well over a century into grand experiments with reinforced concrete, we now know that rusting can develop even before obvious cracking—a process that compromised the concreted-coated stay cables of Genoa's Ponte Morandi leading to its collapse in August

barrier would preserve precious water resources. Sprayed on the walls and supports of a mine or transportation tunnel, a gunite barrier would not only keep out water but would otherwise ensure safety by “making air tight stoppings and fireproofing timbers.”<sup>155</sup>

In his thesis that summarized the first decade of gunite, Lehigh University student Otto Spillman investigated why it was that sprayed concrete was so effective in these applications of impeding water or air. He found that existing cement guns often failed to pull sand through the system of hoses as quickly as they pulled the cement powder, making gunite proportionally higher in cement.<sup>156</sup> Though this made gunite more expensive compared to other masonry or concrete application methods, Spillman concluded that the cement gun created mortar that was less susceptible to voids.<sup>157</sup> And, Spillman noted, due to its efficacy in creating impermeability, the technology did not supplant traditional masonry labor for wall construction so much as it encouraged entirely new applications of concrete.<sup>158</sup>

Practices of mix design that focused on eliminating voids and theories about how to perfectly do so became popular among civil engineers across the country, thanks in no small part to Arthur Newell Talbot. Talbot was a professor at the University of Illinois and a major contributor to that institution’s journal publications on civil engineering that had an extensive readership in the 1910s.<sup>159</sup> Subsequently, other academic engineers built on Talbot’s theory of mix design by focusing on proportion of cementing material to the surface area of the aggregates, with the idea that eliminating voids within the concrete mix

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of 2018 by which forty-three people died. See Guglielmo Mattioli, “What caused the Genoa bridge collapse – and the end of an Italian national myth?,” *The Guardian*, Feb 26, 2019.

<sup>155</sup> Quote from Spillman, 35. Examples of specific impermeable barriers and their goals are found in Spillman, 26-37.

<sup>156</sup> Spillman, 39.

<sup>157</sup> Spillman, 60.

<sup>158</sup> Though non-Gunite reinforced concrete definitely did supplant most brick masonry, in a process described throughout Slaton, *Reinforced Concrete and the Modernization of American Building, 1900-1930*.

<sup>159</sup> These University of Illinois engineering bulletins are widely available online. A piece of evidence for their reach among cement professionals is their presence in the office library of Walter Saunders of the 2 Miracles Concrete Company in Great Falls, Montana. Saunders’ bulletins published between 1904 and 1915 were viewed as unaccessioned items at The History Museum, Great Falls, in Spring 2019.

would certainly require coating each bit of sand or gravel with cement.<sup>160</sup> Through the end of that decade and beyond, the ideal sizing and mixing of aggregates remained a topic of cement science.<sup>161</sup>

### The Problem of Pores: Supplementing Cement's Impermeability

It is hard to overstate the dynamism from the 1870s through the 1910s in cement science and the development of technologies for cement production and use.<sup>162</sup> As already described, industrial geologists and chemists teamed to increase product reliability. That project relied on incorporating methods of chemical analysis into the sourcing of ingredients as well as on adapting petrographic microscopy to surveil cement at various stages of formation. Meanwhile, cement users implemented new testing procedures toward safer and more enduring concrete. At the same time, among the ever-expanding array of applications for concrete were some in which people were encountering the limits of impermeability.

This was a notable departure from hydraulic cement's history in the preceding decades, when the material *was* the waterproofing agent lining canal locks, reservoirs, and cisterns. But in concrete the cement was thinned by sand and gravel, even as the stakes for stopping water had in some applications only increased. Unlike in river-fed canals or rain-fed cisterns, many new concrete structures existed in a context where water loss translated to great cost and liability. Filling a swimming pool entailed paying a utility bill by the gallon, excess moisture in a concrete factory could create microbial issues or damage equipment and products, and water in a basement could destroy items of value. Absent excessive and costly use of cement, as unintentionally occurred with early gunite, users found that concrete sometimes

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<sup>160</sup> Russell Arthur Nelson and Bernard Frank Smith, "A Study of Test Data Showing the Relation of the Compressive Strength of Concrete to the Water-Cement Ratio Space-Cement Ratio and Grading of the Aggregate" (undergraduate thesis, University of Wisconsin, 1926), 4-5, LU.

<sup>161</sup> C. Coopersmith, "Comparison of Fondu, Lumnite and Portland Cements" (undergraduate thesis, Lehigh University, 1925), 7, LU.

<sup>162</sup> One clear representative of cement science's scale in that era is the clinker library, with over 3,000 samples, that the Portland Cement Association began developing at its Chicago headquarters by the era's end. The library is documented, with photographs, in Pivo, "Gospel of Concrete," 46-49.

proved insufficient to prevent seepage of gases and liquids on a scale that was often imperceptible as it happened but generated cumulative effects.

The inventiveness around waterproofing concrete was somewhat distinct in its nature from other cement science undertaken in the same years. It was not driven by the safety issues of increasingly daring concrete structures. Neither was it entirely contained in-house by cement firms, as work on portland cement recipe had become and as was quite typical of this period's industrialization.<sup>163</sup> It was also not particularly advanced by the major professional societies. Instead, the development of waterproofing agents that would eliminate pores altogether, allowing some concrete structures to approach absolute imperviousness, was largely motivated by the financial opportunity in holding a useful patent.<sup>164</sup> A variety of individuals sought such patents, some permanently employed by the industry but others on contract or simply confident they could profit from licensing a successful waterproofing method within the immense business of concrete. As early as the 1870s, a range of tinkerers began patenting materials and processes that built on or supplemented the hydraulic properties of standard cement. They included common construction contractors up to the most authoritative chemists in the field. Most of these interventions entailed the addition of some material, whether it was introduced during cement production, an admixture to the wheelbarrow concrete mélange, or as a coating to be applied on finished concrete.

In 1871, one civil engineer in New York City, Isaac Coleman, patented an improvement to make harder and accentuate cement's hydraulic properties in what was then often called "artificial stone" (concrete). Coleman's process involved adding alum, a mineral compound with various existing industrial applications, to what was then a standard concrete mix combining cheaper lime with expensive portland

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<sup>163</sup> On the transition from individual tinkerers to company laboratories with more systematic research and development, which took place well beyond the cement industry, see Thomas P. Hughes, *American Genesis: A Century of Invention and Technological Enthusiasm, 1870-1970* (Penguin Books, 1989), 159-175.

<sup>164</sup> The various personal and corporate goals embodied in patents is well covered in Hughes, *American Genesis*, which evidences that patent documents took on their own role in technological developments as a purveyor of information to prospective inventors, 82-83.

cement to bind “clean, sharp” aggregates. The stipulation that aggregates be free of debris and angular reflected the already well-known fact that cement best cohered directly onto and around irregular mineral surfaces. But the alum admixture was novel and perhaps created properties that presaged the high-alumina and gypsum blends that portland producers would offer in the early twentieth century. Coleman was maybe right then that the resulting concrete was more durable and more impervious and therefore better suited to various uses including building foundations and pavements than were contemporary mixes.<sup>165</sup>

Two somewhat contradictory patents from 1906, each like Coleman’s in entailing the addition of metal to concrete, demonstrate the breadth of early twentieth-century interest in tailoring concrete’s density to specific structures. One, to Jonas Aylsworth and Frank Dyer of northern New Jersey, in fact aimed to increase porosity via aerating the cement mix.<sup>166</sup> They admixed powdered metals known to generate gas in the presence of water, intending to *decrease* density for buildings in which concrete constituted surfaces while steel beams provided the necessary structural support. The same year, John Rauhoff, a generalist inventor on Chicago’s industrial southern border, aimed to *increase* concrete density for the sake of waterproofing.<sup>167</sup> He patented a compound of any finely pulverized metal, preferably iron, applied as a coating to a finished square of sidewalk or flooring.<sup>168</sup> The metal powder would “impregnate the pores” in typical concrete and then, when simultaneously or subsequently wetted, would corrode or rust, expanding by oxidation to seal the pores. The puffed-up bits of metal increased the concrete’s density, which not only mitigated the structure’s absorption of moisture but increased strength. with concomitant effects on strength and porosity. Rauhoff stated that the compound might be used for other

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<sup>165</sup> Isaac Coleman, “Improvement in the Manufacture of Artificial Stone,” US Patent 120,369, issued October 31, 1871.

<sup>166</sup> Jonas W. Aylsworth and Frank L. Dyer, “Porous Artificial Stone and Its Production,” US Patent 1,087,098, filed June 14, 1906, and issued February 17, 1914.

<sup>167</sup> “John Rauhoff, Tinley Inventor, Passes Beyond,” *Mokena (IL) News Bulletin*, October 21, 1927.

<sup>168</sup> John M. Rauhoff, “Process of Rendering Cement Blocks Waterproof,” US Patent 830,003, filed September 20, 1905, and issued September 4, 1906.

construction materials with pores, including wood. At this microscopic level of concern for permeability, the modern flooring material, concrete, and the traditional wood were not entirely different.

The transatlantic nature of cement science continued into this era of engineering against pores. In 1907, for instance, the United States reissued a patent to Ludwig Hatschek of Vöcklabruck, Austria-Hungary, for fabricating “artificial-stone plates” with hydraulic cement.<sup>169</sup> Hatschek’s concrete plates could resist “atmospheric influences,” which primarily meant water in addition to temperature changes and frost. The plates contained, in addition to the basic concrete ingredients, a fibrous material such as asbestos and an excess of water. Mixing these “intimately” created a pulpy mass that Hatschek likened to “the process of making cardboard.” Hatschek’s explicit parallel to the contemporary industrial papermaking industry demonstrates a wider optimism about the control that standardized and mass-produced materials would afford to people. Regarding concrete, he found that the supplemental fibers along with copious cement generated a product so “well intermingled” as to generate a truly waterproof mass.

Spencer B. Newberry, affiliated with the booming cement production district around Sandusky, Ohio, was another waterproofing patent recipient in 1907.<sup>170</sup> Newberry, who like Meade and Mack was then publishing major works on cement chemistry, had his own ideas for filling pores. They pertained to the production process itself rather than subsequent admixtures or coatings. He incorporated insoluble fatty acids that were to be ground into the clinker that emerged from factories’ kilns. This supplemental material created a cement that went farther, meaning that even when thinned out amid considerable quantities of sand in a concrete mix the results would yet be impervious. Newberry recognized that many inventors were exploring similar saponifying elements— “various kinds of fats, oils and waxes,” but Newberry found that the others remained to some extent soluble.

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<sup>169</sup> Ludwig Hatschek, “Process of Manufacturing Imitation Stone Plates, Slabs, or Tiles,” US Patent 769,078, filed May 11, 1900, issued August 30, 1904, and reissued January 1907.

<sup>170</sup> Spencer B. Newberry, “Waterproof Portland Cement and Process of Making Same,” US Patent 851,247, filed March 13, 1905, and issued April 23, 1907.

The subject of supplemental waterproofing showed up in activity of the National Association of Cement Users (NACU), which began convening in 1905. The NACU's secretary, Charles C. Brown, not only spearheaded the national association but also published annual editions of *A Hand-Book for Cement Users*. Both the books and the published conference proceedings were dotted with references to and advertisements for waterproofing supplements. The Toch Brothers company of New York City used the NACU to advertise "cement filler" and "cement floor paint" that kept water from permeating concrete and dust from settling into it.<sup>171</sup> Newberry's own Sandusky Portland Cement Company advertised its "Medusa Water-proof Compound," the chemist's special saponified cement now with a name that espoused pride in turning everything to stone. The Medusa ad included a photograph of a swimming pool recently constructed in San Francisco (Fig. 1.7), for which Newberry's cement met the obviously exceptional demands for impermeability.<sup>172</sup>

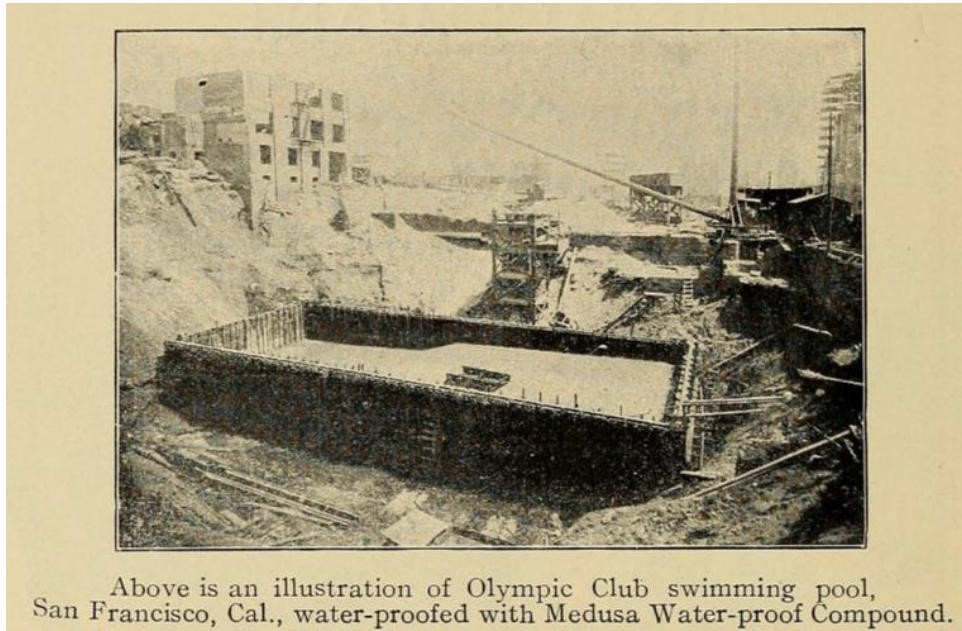


Figure 1.7. Photograph of a construction site in San Francisco, showing a swimming pool being built within the foundation of a future building. The image was advertising the new Medusa brand as a more waterproof cement.

<sup>171</sup> *National Association of Cement Users: Proceedings of the Third Annual Convention*, 343.

<sup>172</sup> *National Association of Cement Users: Proceedings of the Third Annual Convention*, 356.

Development of waterproofing supplements continued apace through the 1910s and even into the 1920s. Some of these were like Newberry's in that they saponified the cement itself as a means of creating waterproofness without increasing the ratio of cement to aggregates in concrete work.<sup>173</sup> Others sought to unlock the potential of "pitchy materials" or hydrocarbons for waterproofing concrete, which seemed so obvious and yet had proven counterproductive to bonding when intermixed cement.<sup>174</sup> Other probers of cement from London to Duluth, Minnesota, all took up the cause of adjusting concrete's chemistry to make it more waterproof.<sup>175</sup>

Many of these cement chemistry experiments in the early twentieth century were reminiscent of Pasley's efforts circa 1830 in that they incorporated a surprising assortment of materials. Among those tested for saponification were "the fatty acids of corn or Chinese wood oil," "fatty acids of fish oil such as menhaden and porgy oil," and "ordinary oleic acid in combination with ammonia." A 1917 patent for waterproof cement involved a "solution of tannin," while one in 1923 featured rye flour with additional "moisture-excluding liquid such as linseed oil" for outside work. Other pore-avoiding or pore-filling additives ran the gamut from a fine carbon material called coke breeze to wood dust to "vegetable soap free from animal oils" to the silicate solutions commonly called "liquid glass."<sup>176</sup> No doubt there was some corresponding variation in how well these supplements created a waterproof concrete, but the

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<sup>173</sup> Abraham E. Horn, "Process of Waterproofing Concrete," US Patent 1,088,022, filed September 18, 1912, and issued February 24, 1914.

<sup>174</sup> Joseph Hay Amies, "Method of Making a Cementitious Plastic Composition," US Patent 1,150,481, filed December 30, 1914, and issued August 17, 1915.

<sup>175</sup> Joseph Freeman Goddard, "Manufacture of Cement," US Patent 1,214,910, filed May 5, 1915, and issued February 6, 1917; Harry Craighill Badder, "Composition for and the Production of Waterproof Cements, Concretes and Mortars," US Patent 1,396,546, filed July 9, 1919, and issued November 8, 1921; Bernard F. Erdahl, "Process of Rendering Concrete Resistant to Waters Charged with Soluble Compounds and Product Thereof," US Patent 1,415,324, filed September 30, 1920, and issued May 9, 1922; Charles Noll, "Plastic Composition," US Patent 1,468,029, filed November 21, 1921, and issued September 18, 1923.

<sup>176</sup> Charles F. Curtis, "Cementitious Compositions Suitable for Flooring, Paving, and So Forth," US Patent 1,460,643, filed August 22, 1921, and issued July 3, 1923; Walter E. Willett, assignor to Con-o-Lite Corporation, "Water, Fire, and Germ Proof Composition," US Patent 1,454,780, filed September 29, 1921, and issued May 8, 1923.

overall result included cements, concrete admixtures, and painted-on coatings that Americans could generally trust to completely seal off basement walls or factory floors.

“Waterproof” had in fact become a stand-in term, representing a quality of cemented structures that no longer only meant impeding water, as it had in the earlier era of canals and reservoirs. In the concrete age, impermeability took on distinctly hygienic implications.<sup>177</sup> These are evident in 1920s products of the Con-O-Lite company of Cortland, New York. The company started in 1923 with a formula for a “water, fire, and germ proof composition” concrete concocted and patented by inventor Walter Willett.<sup>178</sup> The composition resulted from Willett’s quest for a concrete that would be relatively lightweight despite its density and strength. Though Willett made clear the concrete could be used for a range of objects, including table tops and mantles in addition to the typical walls and floors, the Con-O-Lite formula was intended for making burial vaults. Its “water, acid, and germproof” qualities made caskets touted as “The Eternal Safeguard” and sometimes advertised as the Con-O-Crypt.<sup>179</sup> The marketing focused on preserving the dead from “the ravages of soil and moisture” by keeping acidic water and microbes away from a corpse. But certainly of equal appeal was keeping the deceased person inside and preventing their remains from entering the urban water systems that other cemented structures were admirably keeping so healthy by comparison to previous decades.

Spencer Newberry himself was among the deceased by October of 1923, yet he was still receiving patents for the waterproofing of concrete. His final, posthumously recognized contribution could, he had written more than a year earlier, “more perfectly prevent the penetration of water into the concrete through surface voids or pores” than any other water-repelling additive. The intensity of the early twentieth-century search for supplemental impermeability might have resonated with the nineteenth-

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<sup>177</sup> For much more on the role of concrete in Progressive projects of sterilization, see “Chapter 2 - Recasting the Urban Environment” in Lee, “Concrete Dreams,” 76-129.

<sup>178</sup> Willett, “Water, Fire, and Germ Proof Composition,” US Patent 1,454,780.

<sup>179</sup> For just one example, see Con-O-Lite Advertisement, *The Hastings (NE) Daily Tribune*, November 23, 1929, 10, CA.

century cement experiments like Johann Friedrich John and Charles Pasley, or it may have baffled them. The rise of recipe-based portland cement production had entailed the standardization of a material that the earlier scientists would have found sufficiently water-resistant and a suitable resolution to their quandary over cement rock dependency. Yet the concurrent expansion of cement uses and the particulars of using it in concrete had opened up many more questions of cement science by which cement knowledge, including in what was now a niche area of impermeability, had become increasingly complex.

### Cement Knowledge Diaspora

While cement and concrete became evermore standardized around the turn of the twentieth century, a parallel and no doubt contributing development was the flow cement knowledge that began emanating from existing centers of industrial education. Many industrial chemists who either earned degrees in the Lehigh Valley or cut their teeth at the area plants subsequently took their cement experience and knowledge elsewhere. The continent-spanning profusion of cement production and concrete construction in the early twentieth century was supported by the standardized mineral relationships that emanated from the Lehigh Valley. John Leibfried, Lehigh University Class of 1900, stuck around his hometown of Bethlehem for a couple years, taking a job in the local cement industry early in 1902.<sup>180</sup> His industrial chemistry knowledge was a hot commodity, and by the end of the decade Leibfried was a traveling cement consultant. Formally residing in Denver, Leibfried's primary assignments concerned the flourishing cement operations that constituted the town of Portland, near Cañon City.<sup>181</sup> His Denver residence afforded train travel not only on a local route down to Portland but

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<sup>180</sup> J.E. Leibfried, "1902," Box 4, Diaries of J. E. Leibfried 1901 - 1911, Flisher - Leibfried Families Collection, SC MS 0401, LU.

<sup>181</sup> Brooke Johnson, "Back in Time: Fremont County's Portland Once a Booming Industrial Town," *Cañon City (CO) Daily Record*, September 8, 2019.

on transwestern lines by which he regularly visited plants in Kansas and Missouri and made extended trips to the San Francisco Bay area as well as to Juarez-El Paso.<sup>182</sup>

Joseph Mack, the precocious translator of Le Chatelier involved with the Lehigh ACS chapter through 1908, had also left by 1910. His career involved analyzing minerals and standardizing recipes for plants in Kansas, northern Indiana, and, briefly, the west Georgia town of Rockmart, reinvented as a cement district after an earlier period of slate production.<sup>183</sup> Horace Hess presents yet another example of peripatetic cement chemistry work. Hess' formal training is unclear, but he was born in the Valley and became a chemist in the early 1910s while living in Phillipsburg, New Jersey. Hess would then become affiliated with the cement region of eastern Kansas, where he met and began dating local resident Gladys Moore. Their relationship would take on serious distance when he became superintendent of the cement plant in Marlboro, Alberta, nearly 1,500 miles to the northwest.<sup>184</sup> To get married, the two convened in Winnipeg.<sup>185</sup> They would eventually see out Horace's career in the long-established cement district around Louisville but not before years in Rockland, Maine, where Horace led a team of chemists helping convert the local lime industry toward producing Portland cement for use throughout New England.<sup>186</sup>

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<sup>182</sup> J.E. Leibfried, "1909," Box 4, Diaries of J. E. Leibfried 1901 - 1911, Flisher - Leibfried Families Collection, SC MS 0401, LU.

<sup>183</sup> Gretchen A. Brock and John Kissane, "Rockmart Downtown Historic District," Rockmart, Polk County, Georgia, National Register of Historic Places Inventory/Nomination Form, Historic Preservation Division, Georgia Department of Natural Resources, Atlanta, entered June 24, 2009, 13-14; "Joseph Lathrop Mack" in W.J. Maxwell, ed., *General Alumni Catalogue of the University of Pennsylvania* (University of Pennsylvania, 1917), 201, accessed via Ancestry Library Edition, U.S., School Catalogs, 1765-1935.

<sup>184</sup> "Edmonton Portland Cement plant, Marlboro, Alberta," 1914, Image CU190929, Glenbow Library and Archives Collection, Libraries and Cultural Resources Digital Collections, University of Calgary, [https://digitalcollections.ucalgary.ca/asset-management/2R3BF1O3NB\\_C](https://digitalcollections.ucalgary.ca/asset-management/2R3BF1O3NB_C).

<sup>185</sup> "Miss Gladys Moore Married," *The Louisburg (KS) Herald*, December 2, 1920, 1, accessed via Ancestry Library Edition, Newspapers.com Marriage Index, 1800s-current.

<sup>186</sup> "Horace M Hess" in U.S. Bureau of the Census, *Fifteenth Census of the United States, 1930*, Rockland, Knox, Maine, Enumeration District 13, Sheet 2B, Line 62, accessed via Ancestry Library Edition; "Horace Hess," *Caron's Jeffersonville (IN) City Directory 1949* (Caron Directory Co, 1949), 104, Ancestry Library Edition, City Directories, 1822-1995.

Even by 1910, this diaspora had obvious effects. The Lehigh region's dozens of cement mills were still churning out some 20,000 tons of product annually and supplying projects with global recognition, like the Panama Canal. Yet they now accounted for only a third of US cement production.<sup>187</sup> Similarly up-to-date cement plants could be found from Norfolk, Virginia, to Trident, Montana.<sup>188</sup> In no small part, this was a product of individuals who had spent time in the Lehigh Valley and then traveled around the continent to consult on the opening or renovation of cement operations. Standardization of American cements was therefore enacted not simply by words in ASTM publications but by the movement of people who shared a language, instruments and techniques, and, importantly, experiences of engaging minerals that could reliably yield hydraulic cements.

### Conclusion

American cement science through most the nineteenth century had been defined by a select group of civil engineers and industrial entrepreneurs. Their most common activities were geological surveying and rudimentary chemical analysis to identify raw minerals for producing hydraulic properties. By 1920, the network of American cement science and knowledge was vast. It included a wide array of people who were consciously thinking with cement, imagining the possibilities that thoroughly cemented floors and walls might entail, and many more who were also thinking with cement, perhaps less consciously, simply because they lived in close association with many cemented structures. As the binder of increasingly ubiquitous concrete, cement was at once taken for granted by many and a material more intensely studied by scientists than ever before.

Cement science was increasingly defined by the more precise chemistry of production and the national standards used for testing products. Coincident to the standardization of American cements, the

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<sup>187</sup> Lee, 74.

<sup>188</sup> See the 1908 list of cement plants in Lesley, 175-176. Trident, Montana's plant opened in 1910; see "Prominent Men from Montana," *The Ogden (UT) Standard*, March 4, 1910, 8, CA.

role of cement in American infrastructures had taken a definitive turn. Engineers prescribed cement for many more applications beyond canals and harbor structures. Builders, whether long-time professionals or temporary laborers or novice property owners, began using cement more extensively for concrete. The pressing questions of concrete's strength and reliability largely obscured the original interest in cement as a water-resistant material. Yet in truth cement's widespread use in concrete meant the material was often still deployed as a barrier against water, as well as against various other forms of matter.

The continuity within cement science of cultivating properties of water resistance, specifically, and separation or impediment, more generally is evident even through the massive changes around the turn of the twentieth century. To review, those changes involved chemistry laboratories becoming central to cement plants, microscopy becoming a way to monitor the production process, organizations like the American Society for Testing Materials publishing professional standards, and the production and use of new mixing equipment and chemical or physical supplements. Through all of this, an important strand of cement science remained focused on finding materials that blocked water and other elements. Contributions to this strand included careful studies of porosity or voids in hardened cement and concrete as well as of characteristics in potential supplemental waterproofing compounds. Professionals and students alike engaged the problem of voids and the potential solutions by which to fill voids and allow cement to do its best work of enduring cohesion.

Expanded use of cement in the American built environment therefore meant both major changes and a distinct continuity. New associations with cement were rampant. Americans therefore had new ideas and new experiences of what cement did, which depended on specific factors including their locations, their literacy and access to print news, and their professions. Some began to know cement as the material that lined municipal water infrastructures, such as a drinking supply reservoir or a cistern for firefighting. Others began to know cement for aiding a remarkable increase in bridges, some for the ever-expanding railroads and others for new pedestrian and vehicle connections in riverside cities.

Among all these new instances of cement, the barrier property remained central. Just as cement in canals had previously been experienced and imagined by its ability to withstand and exclude water, so it now remained experienced and imagined by its impedimental properties in walling off bridge piers and sealing off reservoir floors. As more Americans lived in a world of cement barriers, the more some of them thought about how to assist cement by engineering density into the built environment. This was a project that joined together the laboratories and collegiate chemistry classrooms with the work of industrial inventors, the capital investments of cement producers, and the engineers who supervised the burgeoning infrastructure projects of American municipalities and corporations.

Cement's ability to impede and separate was important in numerous modern structures, becoming a factor in Americans' twentieth-century experiences, aspirations, and even fears. Cement's participation in the cultural development of the twentieth-century United States proceeded from the history of cement science, though that is not at all to say that cement scientists dictated how exactly people would interact with cement in their everyday lives. Cement scientists—numerous and yet quite limited demographically to white, educated men, having assured that dense mineral barriers were possible and working continually to standardize barrier properties, had little say over how much other individuals would trust cement to impede water, soil, smells, sounds, and living beings. The extent of trust in cement was up to each person themselves, based on their own experience and understanding of the material in any given application, such as a basement, a sidewalk, or a prison cell. Looking anew at the history of these applications is the only way to appreciate the range of cultural notions and practices in which cement participated.

ENVIRONMENTS OF CONFINEMENT: THE AMERICAN  
TRANSITION FROM LIME TO CEMENT IN RELATION TO  
MODERN PRISON CONSTRUCTION

In November 1867, when legislators for the three-year-old Montana Territory convened in the gold mining town of Virginia City, high on their agenda was the construction of a prison. Jails had become crucial to the colonization and consolidation of landscapes into official jurisdictions of the United States. The upper chamber's seven members narrowly voted to locate the prison in newly platted Deer Lodge.<sup>189</sup> *The Montana Post* called the proposed territorial penitentiary “a nice little feather in the cap” for Deer Lodge, a trading post and nascent cattle hub amid a north-south valley that Séliš (Salish) and Qlispé (Kalispell) people traversed for millennia and still did after European fur trappers and American gold prospectors arrived.<sup>190</sup>

In a literal sense, “feather” was not at all what Montana's prison would be. Dr. Armistead Mitchell, a physician and gold speculator appointed territorial prison commissioner, submitted building plans to Secretary of the Interior Jacob D. Cox in late 1869 that portended a hulking three-story mass of cement, brick, stone, and iron. These aspirational prison plans were typical not only in the United States but across Europe and elsewhere, with such structures increasingly a touchstone of civic prestige.<sup>191</sup> The plans entailed an administrative building adjoined by one 70-foot-long stone cellblock, imposing on the outside and confining on the inside. Fourteen cells on each floor—forty-two total—each six feet wide and

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<sup>189</sup> “Montana Legislature; Fourth Session,” *The Montana Post* (Virginia City, MT Territory), November 16, 1867, 2, CA; “The Far-West,” *The Chicago Tribune*, November 30, 1867, 1, CA.

<sup>190</sup> Salish-Pend d’Oreille Culture Committee, “Salish & Kalispel (Pend d’Oreille) History,” 2015, <https://www.thesalishinstitute.com/our-culture/salish-kalispel-pend-doreille-history>, accessed February 20, 2025; Ann Hubber, Dawn Bunyak, and Christine Whitacre, “Grant-Kohrs Ranch,” Deer Lodge, Powell County, Montana, National Historic Landmark Nomination Form, Historical Research Associates and National Park Service Intermountain Support Office, entered September 6, 2001.

<sup>191</sup> David J. Rothman, “Perfecting the Prison: United States, 1789-1865,” in Norval Morris and David J. Rothman, eds., *The Oxford History of the Prison: The Practice of Punishment in Western Society* (Oxford University Press, 1995), 111-129; Guy Geltner, *The Medieval Prison: A Social History* (Princeton University Press, 2008), 7.

eight feet deep, were to be separated by brick walls, two feet thick, that encased each inmate. Mitchell recognized hydraulic cement was then too expensive in Montana to be employed with ideal plentifulness in the prison's construction. Therefore, in soliciting bids he stipulated those bricks and stones be held together by only one part hydraulic cement for every two parts of common lime, by then already kilned in the Territory.<sup>192</sup> Should cement floors prove too expensive, flagstones were allowed to pave the cells. Even so, Mitchell had underestimated cement's cost. When builders' lowest bids came in more than fifty percent over the prison's \$40,000 budget, Mitchell put off the two upper stories and removed all specifications for hydraulic cement in favor of the cheaper lime.<sup>193</sup>

The conspicuous removal of pricey hydraulic cement from Montana's penitentiary design was a rare instance in which easy access to cement—increasingly the essential building material of American prisons—was not simply taken for granted.<sup>194</sup> In this, Montana's isolated geography helps lay bare that a triangular relationship existed between the materials on hand (or at least known of, as hydraulic cement was to Mitchell), the expected role of a prison within society, and the experiences of imprisoned people. As this chapter will demonstrate, that relationship was quite dynamic, in part because the building technologies were so dynamic through the long nineteenth century. First, lime production proliferated to supply a variety of uses, not only in building materials but in agriculture and industry. Next, as detailed in the previous chapter, masons and lime producers identified and exploited specific lime sources that yielded especially cohesive and water-resistant mortars. Gradually, industrialists identified more sources

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<sup>192</sup> Jon Axline, "Lime Kilns Crucial in Helena's Development," in Jon Axline, et al., *More from the Quarries of Last Chance Gulch* (Helena: Helena Independent Record, 1995), 94-97; Jon Axline and Ellen Baumler, "Helena West Main Street Historic District," Lewis & Clark County, Montana, National Register of Historic Places Inventory/Nomination Form, Helena, February 22, 1996.

<sup>193</sup> "Penitentiary," *The New North-west* (Deer Lodge, MT Territory), January 7, 1870, 3, CA.

<sup>194</sup> By the end of the 1800s, cement, delivered with relative ease via railroad, was the material of choice for prison walls regardless of geography. In a striking example, the stockade around New York's Dannemora facility, a location yet surrounded by ample if increasingly controversial timber operations, was replaced in 1887 by thick and tall stone masonry walls that decreased both maintenance requirements and chance of escape. See Clarence Jefferson Hall, *A Prison in the Woods: Environment and Incarceration in New York's North Country* (University of Massachusetts Press, 2020), 48.

and synthesized replicate materials that became known as hydraulic cement, portland cement or, simply, cement. All the while, modern prison construction propagated across the municipalities, counties, and states of the expansionist nation.

The nineteenth-century trend of increasing lime and then cement use in American prisons went hand-in-hand with a trend of increased intent to separate individual prisoners one from another. The goal was to isolate prisoners, if not around the clock then at least during the hours when he was not engaged in labor. Deer Lodge's thirteen cells built for that purpose in 1870 were each meant to hold one prisoner. Deer Lodge's warden oversaw a system that consciously copied the celebrated prisons built across the northeastern United States in preceding decades. It especially matched the well-known facility in Auburn, New York. The hope at Auburn—and especially at its peer facility, Eastern State Penitentiary in Philadelphia—was to render socialization impossible so that each convict would instead stew in his own thoughts until he inevitably came to reflect upon what had brought him into these circumstances. The last step on this solitary mental journey was supposed to be genuine penitence, forcibly but mercifully brought about primarily by the penitentiary's isolating structure. By erecting a building that imparted extreme isolation, Dr. Mitchell's commission not only advanced Montana toward statehood, but also placed the outpost of Deer Lodge squarely within the evolving cultural, architectural, and environmental phenomenon of modern American corrections.<sup>195</sup>

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<sup>195</sup> A handful of architectural historians, led by Norman Johnston, have covered the many phases that prison design in the United States, and around the world for that matter, went through from the late 1700s to the accelerating mass incarceration of the late twentieth century. Johnston was typical of these historians in studying prison architecture as a reflection of a society's views on crime and punishment, with little to no account for how environment and technologies themselves shaped either those views or the architectural decisions. His work and that of others has nonetheless provided vital context for this chapter's interpretation of historical prison spaces. See Norman Johnston, *The Human Cage: A Brief History of Prison Architecture* (New York: Walker and Company, 1973); Morris and Rothman, *The Oxford History of the Prison*; Norman Johnston, *Forms of Constraint: A History of Prison Architecture*. (University of Illinois Press, 2000).

In most instances, a relationship between the history of building materials and the history of American carceral cultures is not obvious. Dense walls, sterile surfaces, and small chambers have been the default features of US prison cells for so long as to fall out of most discourse on incarceration. It is also taken as the norm that US prison cells are intended to effect, and in most cases are experienced as, a punishingly austere physical separation that complements geographical separation from family, friends, and other associates. When the first inmates were received at Deer Lodge in 1871, however, the local paper celebrated the “comfort, care and safety” this facility would provide relative to the decrepit county jails from which they were transferred.<sup>196</sup> As incongruous as comfort and total isolation may sound today, at the time, reform-minded activists had for generations espoused masonry’s potential to isolate and cure criminality, which many conceived of as a contagious disease.

A chronicle of cement’s role in prison cultures is largely an account of the remarkable shift in solitary confinement from a putatively rehabilitating treatment supplemented by fresh air and gardening to a nakedly punitive, absolute separation. Prisons, and especially the floors and walls of cells, were a category of structure in which both the quantities and the precise specifications of cement developed more rapidly than in most other uses aside from the canal and harbor structures mentioned in chapter one. Prisons were, in fact, a significant laboratory for developing precursors to what we now call concrete. That experimentation with cement, and with lime, led to greater isolation in prisons. Separation meant not only from other people, whether on the outside or on the inside, but also from many of the sensory experiences that reward and occupy the human body. Imprisonment across the United States commonly included at least a dose of extreme isolation. Many nineteenth-century architects intentionally offset masonry’s harshness with wooden floors and officials generally provided each inmate with a means of occupation that seemed to at least somewhat blunt the solitude. Even so, from the start, witnesses called this treatment harmful and therefore inhumane. Yet advocates, including prison doctors, gave extreme

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<sup>196</sup> “Transfer of Prisoners,” *The New North-West*, July 1, 1871, 3.

isolation full-throated defenses, justifying it as ultimately effective in morally reforming convicts. Only after decades of being defended as this necessary evil did isolation become an admittedly harsh punishment for those suspects suspected of or found to have threatened the order within a prison. Cement, once conceived of as a collaborator whose tough love might guide prisoners back to God, became embraced as a cold, sterile material—sanitary enough to keep the confined technically alive while otherwise wringing the life right out of them.

What follows is far from the first history of modern prisons.<sup>197</sup> But it continues filling in the gaps of modern prison history by chronicling the literal filling in of gaps in modern prisons, detailing why, how, and to what effects modern US prisons became spaces defined by cement. Despite the legacies they elucidate, previous studies that characterize modern prisons by a prototypical regime of surveillance and

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<sup>197</sup> The best known is Michel Foucault, *Surveiller et punir* (1975), cited here as Michel Foucault, *Discipline and Punish: The Birth of the Prison*, trans. Alan Sheridan (New York: Pantheon Books, 1977). It describes the administrative and institutional processes through which state and class powers operated in France and elsewhere from the seventeenth century into the early nineteenth century. Though an immensely important critique of inequities inherent to systemic incarceration, *Surveiller et punir* has obvious shortcomings as a historical study. For one, in service of articulating the critique, Foucault described many true novelties of modern prisons, yet his characterization was largely singular and stagnant rather than reflecting the true variegated and dynamic landscape of carceral facilities. This elision went hand-in-hand with describing incarceration only as a power relationship between the prisoner and the imprisoned, which it was, but not somehow outside of the physical and temporal context of actual prison structures (in contrast with idealized prison structures on paper, as was Jeremy Bentham's famous 1791 plan for panopticon surveillance). Also worth mentioning here is Foucault's dismissal of the epidemiological rationale behind the modern French prisons he described. Those institutions and policies reacted to the plague, a bacterium now called *Yersinia pestis*, that had horrifically infested and overcome around one million people living in France circa 1630 and then endemically reappeared for nearly a century thereafter. Though bacteria of course did not dictate human social responses, they were a real factor in modern institutionalization. See Geoffrey Parker, *Europe in Crisis: 1598–1648* (Wiley, 2001). An ongoing book project by historian Jérémie Foa, "Une Grande Froidure": An Environmental History of the Wars of Religion (<https://www.imer.fr/en/researcher/jeremie-foa/>, accessed January 28, 2025), elucidates how the Little Ice Age contributed to the death-filled social instability that preceded modern state building in France. Other context missing from Foucault's account includes the substantial precedent for carceral administrivia and institutions in Western Europe, which dated to at least the late thirteenth century. This shortcoming was noted and rectified by medieval prison historian Guy Geltner, who directly addressed the myopic notion of modern prisons as "essentially the brainchild of post-Enlightenment penology." See, Geltner, *The Medieval Prison*, 6-11, for a synthesis and contextualization of several important developments in prison history (quotation from page 10). On thirteenth-century prisons see also, Johnston, *Forms of Constraint*, 25.

categorization are ahistorical. Prison systems are, in fact, a continually evolving and profoundly personal realm. An environmental history of US prisons focused on building materials offers a means of recognizing important nineteenth-century legacies without obscuring the dynamism and contingencies that have always characterized modern prisons. Relentless state power of surveillance is, as Michel Foucault famously argued, an important thread in prison history. But that activity happened in specific spatial configurations amidst material technologies. Each US prison has always been a unique site inhabited by individuals. At the same time, concrete materials is a noteworthy continuity in ongoing US mass incarceration.<sup>198</sup>

### Mortar Makes the Modern Penitentiary

In 1705, English settlers continued to indulge temptation and illegally take reserved agricultural land from the Tunxis and other disease-diminished indigenous populations near the Farmington River in the Connecticut Colony.<sup>199</sup> The river, only forty-some miles in length, changed its course drastically to circumvent long ridges of unyielding trap rock. That year, some English turned their speculative gaze

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<sup>198</sup> US mass incarceration is an ongoing program of federal and state prison construction, in addition to its widely known definition as a statistical phenomenon by which the country consistently ranks among the very highest in its per capita rate of incarceration. See the World Prison Brief's table "[Highest to Lowest – Prison Population Rate](#)," accessed February 18, 2025. Since the 1960s, national political platforms have featured sweeping ideas that have become state and federal policy on prison construction and operational budgets as well as on sentencing and parole. At any time over the last decade between 1,200,000 and 1,600,000 people have been prisoners in the United States. See, E. Ann Carson and Rich Kucklow, "Prisoners in 2022 – Statistical Tables," NCJ 307149 report for the U.S. Department of Justice Bureau of Justice Statistics, November 2023, <https://bjs.ojp.gov/document/p22st.pdf>, accessed February 18, 2025. The extent of the carceral economy seems to invite political polarization between supporters and abolitionists. Anthropologist Lorna Rhodes, in her study of Washington State prisons, argues that this tendency toward wholesale characterization and taking sides does not help to reduce systemic harm that she calls "wasteful and damaging forms of institutional life." See Lorna A. Rhodes, *Total Confinement: Madness and Reason in the Maximum Security Prison* (University of California Press, 2004), 6-9. While today's prison abolitionists might make a good case against Rhodes' stance, her argument helps us think about prison materials as vital to the corrections industry as we know it and therefore also as an avenue toward a more just system.

<sup>199</sup> Christopher P. Bickford, *Farmington in Connecticut* (Farmington Historical Society - Phoenix Publishing Co., 1982), 21, 41-42.

away from the valley floors and up onto these rocky escarpments, specifically to a site where rocks showed the pale green hue indicative of copper ore.<sup>200</sup> On and off again through the seven decades that followed, a parade of novice prospectors, enslaved black and indigenous laborers, and some professional miners picked away at a seam of stone that held too little metal to turn a profit in the industrial and political realities of the Connecticut Colony. In retrospect, their desultory efforts presaged something more than just mining. As they extracted rock and left a small chain of claustrophobic caverns with just enough ventilation to keep a person alive, the workers had been building the State of Connecticut's first prison.

In 1773, Connecticut's colonial administration identified the abandoned mines as a potential site for detaining those convicted of crimes largely relating to private property, including burglary, robbery, and counterfeiting.<sup>201</sup> Colonial authorities ordered that the existing mine shafts should, with almost no modification, be made a prison. Gradually, and in reaction to not infrequent escapes, the authorities added more masonry and iron grating to this pit in the earth. However, less than two years into the project, those British authorities became just as likely to inhabit the spaces as any conventional convict: Rebels began impounding Loyalist leaders there, by some accounts reveling in their political foes' exposure to the moisture and filth and the unremitting darkness.<sup>202</sup>

After the Revolutionary War, colonists subscribed even more deeply to that previous colonial government's construction practices. They wanted to house institutions of the newly independent states in buildings that replicated the mortar and stone edifices of London and Birmingham, erected by skilled masons at the direction of experienced architects, that many were familiar with. Officials in Connecticut joined their New York counterparts in naming the new state prison Newgate after the infamous

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<sup>200</sup> Bickford, *Farmington in Connecticut*, 137.

<sup>201</sup> People used mines or quarries for imprisoning others in ancient times. See Johnston, *The Human Cage*, 5.

<sup>202</sup> Alexis M. Durham III, "Social Control and Imprisonment During the American Revolution: Newgate of Connecticut," *Justice Quarterly* 7, no. 2 (1990): 293-323.

penitentiary in London. This was wholly aspirational, since unlike New York's theirs remained a modified hole in the ground.<sup>203</sup> The original Newgate Prison had in fact recently undergone an expansion and renovation that employed *architecture terrible*, a neologism of the decade.<sup>204</sup> This meant Newgate's architects intended that the building's imposing stone and mortar walls should unleash psychological effects that would not only deter criminal behavior among those passing on the outside, but would also set the standard of strength and rigidity that guards were expected to equal in their dealings with inmates. This was not, of course, a building style wholly invented for prisons. Indeed, Jacques-François Blondel, credited for coining the phrase *architecture terrible*, likely understood that castles and like fortifications had already shaped people's minds, and that this justified an intentional practice of eschewing any effort to adorn or conceal the misery of prisons' cold and foreboding stone masonry.

While colonists adopted many aspects of English institutional construction, they struggled with the degree to which they should also embrace its associated penal discipline philosophy. Initially, English colonial authorities had practiced more leniency than in the imperial homeland, where capital and corporal punishments were common. In the eighteenth century, however, Pennsylvania's authorities adopted harsher punishments and prescribed them for a broader range of behaviors. Discriminatory rules concerning extra-marital reproduction suggest that this was in part a manifestation of leaders' worries about increasing ethnic and racial heterogeneity among the colony's residents, especially in the bustling port of Philadelphia. Yet under the cloud of xenophobic selective penalties, the colony also seems to have faced genuinely new transgressions as its growing population included significant disparities in wealth. Burglary, highway robbery, counterfeiting, and theft of livestock were capital offenses that routinely came

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<sup>203</sup> W. David Lewis, *From Newgate to Dannemora: The Rise of the Penitentiary in New York, 1796–1848* (Cornell University Press, 2018).

<sup>204</sup> Jacques-François Blondel, *Cours d'Architecture, ou Traité de la Décoration, Distribution et Construction des Bâtimens* (Paris: Desaint, 1771), 423-426. Interestingly, Foucault, who knew well the modern turn away from conspicuous public punishments like pillorying and hanging, did not recognize the continuing publicity of punishment as effected by *architecture terrible*, arguing instead that reformers circa 1800, including those in Pennsylvania, completely concealed the state-sanctioned violence against imprisoned people.

before Pennsylvania's Supreme Court in the 1760s and 1770s.<sup>205</sup> Yet while those convicted of property crimes could be executed, like their counterparts convicted of murder or sexual assault, they more often endured punishment that combined public whipping, payments, and imprisonment. Since the crimes themselves reflected the materiality reality of increasing but uneven wealth in the colony, it is perhaps true that the new practices of sentencing reflected the same reality. In essence, colonists who saw progressive development of industries, markets, and structures might have found it easier to believe that a criminal could also be made to progress and therefore did not need to be permanently removed.

At this time, a group of Philadelphians began calling for a pointed departure from previous penal practices, a departure that relied on new construction to be its vehicle. These Philadelphians espoused the same ideas as wealthy Englishman John Howard, who in the 1770s set about to end the practices of guards wantonly beating and extracting fees from prisoners.<sup>206</sup> In 1773, before Philadelphia's elite became preoccupied with the matters of independence from Britain, their nascent formal organization to reform prisons earned its first legislative success. The provincial general assembly agreed to fund a new jail in Philadelphia. The city's existing High Street Jail, a simple stone structure then fifty years old, was overflowing. Many were confined in a large common holding room, most awaiting due process, return to an enslaver, or the materialization of means to pay fines and fees.<sup>207</sup> The new Walnut Street Jail reflected an understanding that upfront investment in construction could build solid walls designed to segregate these obviously distinct categories of jailed people—especially from the more violent and potentially corrupting convicted offenders.<sup>208</sup>

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<sup>205</sup> Lawrence H. Gipson, "Crime and Its Punishment in Provincial Pennsylvania: A Phase of the Social History of the Commonwealth," *Pennsylvania History* 2 (January 1935): 3-16.

<sup>206</sup> "John Howard: British philanthropist and social reformer," *Encyclopaedia Britannica*, updated January 16, 2025, <https://www.britannica.com/biography/John-Howard-British-philanthropist-and-social-reformer>, accessed February 18, 2025.

<sup>207</sup> Rex A. Skidmore, "Penological Pioneering in the Walnut Street Jail, 1789-1799," *Journal of Criminal Law and Criminology* 39, no. 2 (1948): 167-180.

<sup>208</sup> At the time, those charged with violent crimes were likely to receive capital punishment. Therefore, the penitentiary was intended to cure criminality and replace it with independent productivity, a use of police power wholly in keeping with Foucault's findings that connect capitalism and policing in modern Western

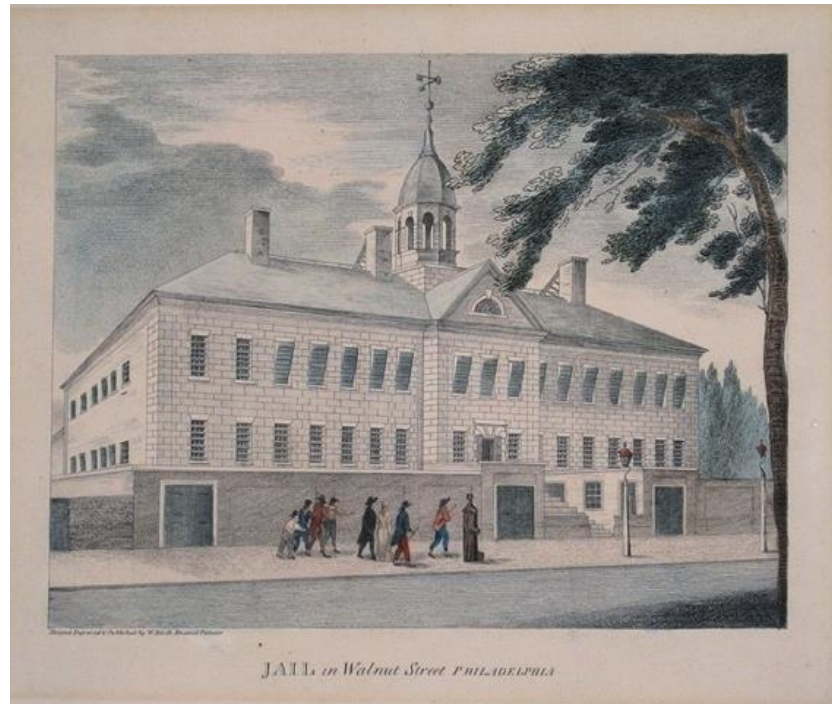


Figure 2.1. Walnut Street Jail’s exterior, with its carefully laid masonry and cupola, presaged other new institutions of independent Philadelphia.

With its solid masonry exterior (Fig 2.1) appearing as a more foreboding form of some educational or legislative institution, the Walnut Street Jail soon contributed to the legitimization of Pennsylvania officials’ sovereignty as the colony gained independence from Britain. That sense of legitimacy came a bit ironically, by adopting English construction practices that American public officials and architects would continue to replicate as faithfully as possible well into the nineteenth century. Yet Walnut Street was also perhaps the start of what prison historian Clarence Jefferson Hall, Jr. has called a “surge of nationalism” among civic leaders in the form of establishing penal codes that were somewhat fairer than European law enforcement procedures that often entailed building structures for

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political philosophy and practice. See, “19 January 1972” in Michel Foucault, *Penal Theories and Institutions: Lectures at the Collège de France, 1971-1972*, Bernard E. Harcourt, ed., trans. by Graham Burchell (Palgrave MacMillan, 2019), 93-96.

incarceration.<sup>209</sup> The new Walnut Street jail was more than a symbol of nationalism. It was a tangible masonry structure many consequences that also included a new culture of incarceration.

In their 1776 state constitution, Pennsylvania officials codified confinement and forced labor as preferable to and obviously “less sanguinary” than executions. At the time, Pennsylvanians could face death for fourteen different convictions ranging from murder to burglary to counterfeiting.<sup>210</sup> In great contrast to capital punishment, and as a supposed distinction from the debilitation and debasement of public corporal punishments, civic leaders in Philadelphia reimagined prisons as a sort of life support system for moral rehabilitation. Richard Wistar, Sr., one of the city’s several prison reform movement leaders, would for decades be remembered as the man who distributed at the city’s Market and Third streets jail “wholesome soup prepared at his own dwelling.”<sup>211</sup> Collaborating with new prison structures, Wistar and other society men and their families began to articulate, like John Howard explicitly did before Parliament in 1779, a *penitentiary* concept of sentenced confinement. That is, a place deliberately designed so that criminals could come to repent their misdeeds and reemerge as reformed and useful citizens. It was a third route set against both capital punishment and the catch-and-release practices of corporal and monetary punishments.

The budding penitentiary concept meant rehabilitation and correction through an idealized process that relied heavily on the ability of modern architectural designs and materials to guide the prisoners rather than simply confine them. The convicted would all have to serve out a specified amount of time within the prison walls. The walls would, in addition to and perhaps more important than preventing escape, hold the criminally convicted safe from the undesirable influences of one another. The walls would also, reformers believed, have the beneficial effect of blocking out anything that might

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<sup>209</sup> Hall, *Prison in the Woods*, 3.

<sup>210</sup> *Letter Report and Documents on the Penal Code from the President and Commissioners Appointed to Superintend the Erection of the Eastern Penitentiary, Adapted and Modelled to the System of Solitary Confinement* (Harrisburg: S.C. Stambaugh, 1828), 2, LCP.

<sup>211</sup> Robert C. Moon, M.D., *The Morris Family of Philadelphia, Vol. II* (Philadelphia: Robert C. Moon, 1898), 521.

distract a prisoner from the essential self-examination leading ultimately desired goal of penitence. Here, the largely Anglican leadership of Philadelphia's prison reform movement straddled the conventions of Roman Catholic monasticism and the radical Protestantism of their Quaker neighbors. The material environments effected by modern masonry presented themselves as a way to force the isolation, ascetism, and self-reflection of a monastery upon wayward souls, thereby helping each individual re-establish the direct connection with God that they were meant to have. As historian of prison architecture Steven Niedbala notes, there was a second line of thinking in prison advocacy during the first decades of the United States beside the belief in moral rehabilitation of productive citizens. These parallel advocates believed punishment was acceptable but desired its rationalization and humanization, which they trusted the same form of modern facilities would deliver.<sup>212</sup>

The spiritual and material were fused by taking the known quantity that was masonry construction and employing it to imagine prisoners separated from one another both physically and sonically. With this vision in mind, Philadelphia's prison reformers grew ever more certain that the new Walnut Street Jail was inadequate. It did not have sufficient interior masonry to comfortably shield the (supposed) penitent-to-be from water and wind and biota, to preclude their overexposure to outside light and sound. Worse, its sixteen cells intended for single occupancy, and therefore a supposedly healthful segregation of inmates, were perpetually misused due to overcrowding, as other jurisdictions in Eastern Pennsylvania sent inmates there to relieve crowding in their own jails. Walnut Street, sturdy and legitimizing *architecture terrible* that it was, now drew the wrath of the very same social reformers who initiated its construction. Upon inspection, Episcopal bishop Rev. William White contrasted its hodge-podge environment with the ideal penitentiary that would guide miscreants into law-abiding life.<sup>213</sup> So

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<sup>212</sup> Steven Niedbala, "Techniques of Carceral Reproduction: Architecture and the Prison System in the United States, 1799-1978" (PhD Dissertation, Columbia University, 2020), 1-2.

<sup>213</sup> Negley K. Teeters, "Pennsylvania Prison Society--A Century and a Half of Penal Reform," *Journal of Criminal Law and Criminology* 28, no. 3 (Fall 1937): 377.

began a period of frustration for prison reformers, in Philadelphia as in England, where John Howard's original proposals for true penitentiary construction remained unrealized.

Philadelphia reformers also saw support for their penitential prison eclipsed by great interest in new institutions of the city's built environment. Philadelphia was increasingly a reputable place thanks to new masonry structures. Among the contributing projects were an expansion of the Pennsylvania Hospital, the erection of Congress Hall for national legislative proceedings, the establishment of a permanent home building for the Library Company, and the construction of various private estates and churches on the city's perimeter.<sup>214</sup> The prison was being left behind.

On May 8, 1787, several eminent residents of Philadelphia, including Dr. Benjamin Rush and Wistar's son Thomas and Rev. White, gathered at the three-story brick home of the merchant Isaac Parrish.<sup>215</sup> There, just across Second Street from Christ Church and its towering, aspirational steeple, the assembled renewed their practice of enumerating grievances against the local penal system. That system, which they characterized by its corrupt jailers and abused prisoners, had long operated through the old prison only one and a half blocks from the Parrish home. It now seemed reincarnate at the new Walnut Street Jail. In the glimpses they had been afforded, they saw prisoners inside suffering from cold, hunger, unclean quarters, physically harsh treatment, and an environment of idleness and inebriation that all but ensured the state of financial and moral poverty in which many entered would continue upon their release. On that day in early May, these several concerns long held by powerful residents coalesced into a formal organization, The Philadelphia Society for Alleviating the Miseries of Public Prisons (hereafter, the Prison Society).<sup>216</sup>

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<sup>214</sup> Thomas G. Morton and Frank Woodbury, *The History of the Pennsylvania Hospital, 1751-1895*, 2<sup>nd</sup> rev. ed. (Philadelphia: Times Printing House, 1897); "At the Instance of Benjamin Franklin: " *A Brief History of the Library Company of Philadelphia* (Philadelphia: The Library Company of Philadelphia, 2015), 29-31; Russell Frank Weigley, Nicholas B. Wainwright, and Edwin Wolf, eds., *Philadelphia: A 300-Year History* (W.W. Norton & Company, 1982), 171-176.

<sup>215</sup> Description of the Isaac and Sarah Parrish home based on Frank H. Taylor, "At the Corner of Pewter Platter Alley," image number 95, Frank H. Taylor Illustration Collection, LCP.

<sup>216</sup> Teeters, "Pennsylvania Prison Society--A Century and a Half of Penal Reform," 374.

One foundational misery for which the society members blamed the lack of cleanliness, the abusive disciplining, and the drunken misbehavior of prisoners toward one another, was what they viewed as dangerous amalgamation of persons in the city's jails. Walnut Street had become a jail like others in that it was effectively a congregate holding pen for those awaiting trial and those already enduring punishment in the form of daily manacled excursions to perform unpaid labor in Philadelphia's streets. The Philadelphia reformers latched onto a fantasy about what even more extreme separation, really isolation, could do. The fantasy entailed collaborating with even more rocks and mortar to build individual cells that would go beyond separating men from women and the untried from the convicted to instead separate each imprisoned person unto themselves. Enduring this degree of isolation around the clock somewhat replicated how monks had long been punished for misconduct, and in fact the separation cells had a very monastic intent. Totally sealed off from people and things, with exceptions made only for delivering food and removing waste and providing moral instruction from visiting clergy or laity, the imprisoned would supposedly be left no other option but to stew in their own thoughts. In this paternalistic fantasy, the sequestered prisoner would inevitably become remorseful, opening a path for each convict to be morally recreated in renewed conversation with a largely abstract God, and at the end of that path the penitent and rehabilitated person would be released from the prison. Cellular separation would also spare each prisoner from the threats that fellow prisoners posed to further corrupt or to cause regressions on the path to penitence. The reformers wanted to build an entirely new structure to this end, but with Walnut Street still new, and the necessary funding was not forthcoming. In the late 1780s, they instead caused to be built a two-story, sixteen-cell unit within Walnut Street's courtyard (Fig. 2.2).<sup>217</sup>

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<sup>217</sup> Sarah Childress, "A 'Noble Experiment': How Solitary Came to America," *Frontline*, WGBH, April 22, 2014, <https://www.pbs.org/wgbh/frontline/article/a-noble-experiment-how-solitary-came-to-america/>, accessed February 19, 2025.

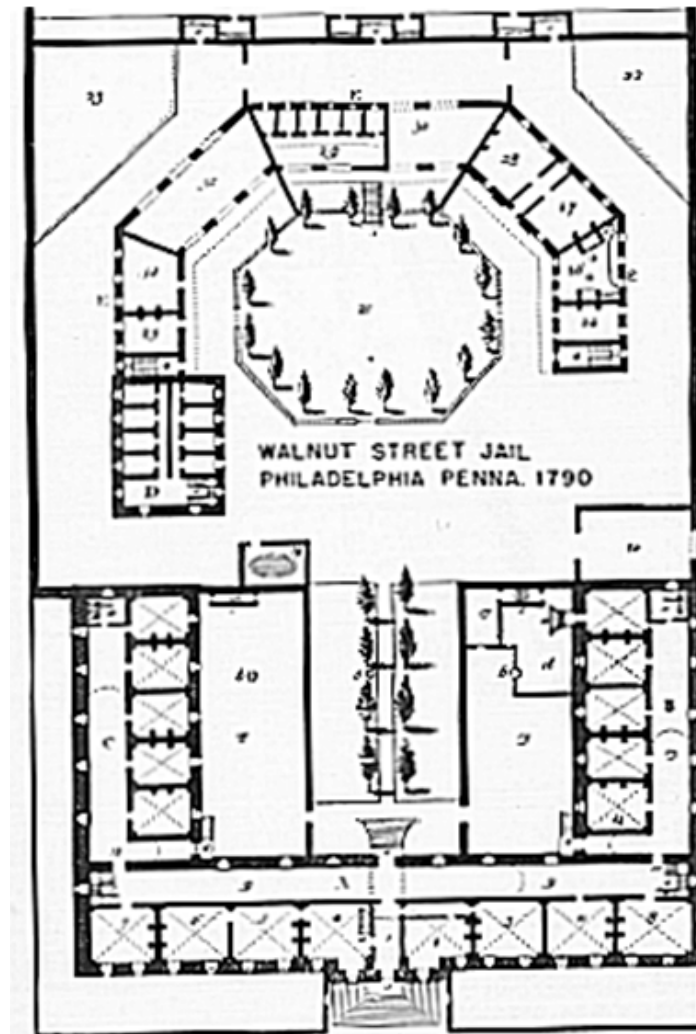


Figure 2.2. From the start, the interior of Walnut Street included a greater number of separated chambers than previous jails. However, the only true cells for individual confinement (labeled “D”) were added later as infill and comprised only a small part of the total floor plan.

The Prison Society pressed on with a 1788 platform claimed that separation and manual labor performed in isolation would “more successfully tend to reclaim the unhappy objects...and the evils of familiarizing young minds with vicious characters would be removed.”<sup>218</sup> The ideal system would go beyond custody, even beyond simple confinement, to, as the later prison reformer William Parker Foulke

<sup>218</sup> *Letter Report and Documents on the Penal Code...*, 2. Here, separation is clearly about keeping prisoners one from another. This differs from the administrative categorization and separation from society that Foucault described in France, though those elements were also involved in Pennsylvania.

would recount it, effectively “prevent the inmates of our jails from associating together.”<sup>219</sup> The Prison Society’s position was that prisoners should be dissociated because separation would prevent not only the reproduction of criminality but also its festering within an individual. The Society was going all-in on imprisonment as an act with reformatory intentions rather than only deterrent intentions.

The General Assembly of Pennsylvania, persuaded by the Prison Society, passed sweeping prison reform in 1790. Gendered separation of prisoners became official state policy as did separation of convicts from the untried and the debtors. New policies provided for feeding and clothing prisoners, while banning hard alcohol and the practice of jailors taking payments or garnishing prisoner’s income. Showing deep influence of the Society’s wishes, the state introduced religious instruction, restricted social conversation in jails, and began a more rigorous classification of prisoners for both administrative and daily function purposes.

The new policies of separation and restriction went hand-in-hand with building materials. The bill’s supporters knew even jails like Walnut Street, solid and somewhat subdivided as it was, could not affect the ideals to which the new policy aspired. However, the Legislature balked at funding an entirely new structure in Philadelphia so soon after Walnut Street. The bill that passed in April of 1790, appropriated only enough money to add several more cells, each forty-eight square feet with a nine-foot ceiling, that all fit within part of the jail’s external yard. The walls were to allow just enough air and daylight for life and otherwise “prevent all external communication.” Under the new system of segregation, sixteen existing single-occupancy cells were reserved for “atrocious offenders” who needed both the most help toward personal reformation and the least opportunity to socially contaminate

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<sup>219</sup> William Parker Foulke, *Remarks on the Penal System of Pennsylvania: Particularly With Reference to County Prisons* (Philadelphia: Isaac Ashmead, for the Philadelphia Society for Alleviating the Miseries of Public Prisons, 1855), 9, HSP.

others.<sup>220</sup> In 1794, an additional act of the Pennsylvania legislature made only murder a capital offense. All other felony convictions thereafter would translate to a prison term.<sup>221</sup>

For more than two decades, then, the Prison Society members had looked on as Walnut Street's mishmash of cells and congregate rooms again and again failed to effect both the interpersonal segregation and the environmental control they desired. Yet even as their frustrations were mounting, the region's construction industries were moving ahead, offering new material solutions to the problem of prisons. Most important were the local developments in technologies of cement. Lime makers in southeast Pennsylvania began to kiln at scale specifically for masonry projects, ultimately creating an abundance within which builders began to discern desired types of mortar.<sup>222</sup> The many Americans who kept abreast of English practices would have likely heard about James Parker's 1797 "Roman" cement, described in the previous chapter, and the related hydraulic cements increasingly in use across the Atlantic. Each year the materials of separation were more available than before, while Pennsylvania's prison reformers wrung their hands over Walnut Street continuing to be a sort of social club for the criminally inclined.

The Prison Society routinely communicated their frustrations with these many failings to State of Pennsylvania authorities. In December of 1801, Society president William White delivered an appeal to the legislature that they should, at Walnut Street but presumably elsewhere as well, "separate the convicts from all other descriptions of prisoners." They made clear their dissatisfaction with the *ad hoc* and somewhat haphazard use of masonry within Walnut Street, which was not delivering the quiet and focused reform experience that modern materials allowed them to imagine and potentially realize. In

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<sup>220</sup> George W. Smith, *A Defence of the System of Solitary Confinement of Prisoners Adopted by the State of Pennsylvania*, 2nd ed. (Philadelphia: E.G. Dorsey, 1833), 13-14, LCP; The number of original individual cells (16) at Walnut Street is reported in Thomas B. McElwee, *A Concise History of the Eastern Penitentiary of Pennsylvania, Vol. 1* (Philadelphia: Neall & Massey, 1835), 5, Colena Digital Repository of the University of Pennsylvania, <https://colenda.library.upenn.edu/catalog/81431-p39k46c7z>.

<sup>221</sup> *Letter Report and Documents on the Penal Code...*, 2.

<sup>222</sup> Joyce A. Post, "Great Valley Area Limestone Quarries, Part 2: Cedar Hollow Quarries," *Tredyffrin Easttown History Quarterly* 42, no. 4 (Fall 2005): 117-133.

1803, the Society registered another formal request “to adopt the mode of punishing criminals by solitary confinement at hard labor.”<sup>223</sup> Ultimately, state action was not forthcoming until 1817, when independent prison inspectors adopted Society language and corroborated their concerns. The inspectors complained to the state that a growing prisoner population simply could not be expected to improve into morally upright and industrially productive citizens in the existing space, which moreover fostered the spread of disease among them.<sup>224</sup> They perhaps took some inspiration from the 1816 opening of London’s new Millbank Penitentiary, which eventually amounted to a Royal investment of some £400,000 (£50 million in 2025) in mortar and other materials that created individual isolation.<sup>225</sup>

In 1818, the Philadelphia Society again petitioned the State Legislature. Their mission was now statewide. They advocated multiple penitentiaries that would each serve a jurisdiction. New complexes would allow “the more effectual employment and separation of the prisoners” that in turn would demonstrate “the efficacy of solitude on the morals of those unhappy objects.”<sup>226</sup> Historian of institutionalization David Rothman argued that reformers found purchase because of the era’s Jacksonian democracy. Borrowing American historian Frederick Jackson Turner’s definition of the era by the frontier’s influence on culture, Rothman noted that increasing mobility and openness in expansionist America created attendant popular fears about the disintegration of social order.<sup>227</sup> Also of note, throughout the nineteenth century across England and Europe, officials responded with increased policing and incarceration to the disparities and vulnerabilities of urbanization and capitalist industrialization—

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<sup>223</sup> McElwee, *A Concise History of the Eastern Penitentiary of Pennsylvania, Vol. 1*, 5.

<sup>224</sup> *Letter Report and Documents on the Penal Code...*, 3.

<sup>225</sup> Gibbons Merle, "The Millbank Penitentiary," *Chambers's Edinburgh Journal* 8, no. 402 (Oct 12, 1839): 298.

<sup>226</sup> McElwee, *A Concise History*, 5.

<sup>227</sup> D.J. Rothman, “Social Control - The Uses and Abuses of the Concept in the History of Incarceration,” *Journal Rice University Studies* 67, no. 1 (1981), 9-20. On Turner’s definition of Jacksonian democracy, see Richard J. Moss, “Jacksonian Democracy: A Note on the Origins and Growth of the Term,” *Tennessee Historical Quarterly* 34, no. 2 (1975): 145–53.

processes that also occurred in Eastern Pennsylvania, earlier than most anywhere in the United States.<sup>228</sup>

From a combination of those motivations, Pennsylvania's legislature complied with the Society via a gradual two-penitentiary plan that immediately funded what would become Western State Penitentiary at Pittsburgh. Eight years of construction followed, realizing the architect William Strickland's plan for a round, castle-like exterior of three-foot-thick stone walls around a wheel of 190 isolation cells, each six feet by nine feet.<sup>229</sup> The design was inspired by the philosopher Jeremy Bentham's famous 1791 plan for a "panopticon" prison by which a single guard in a central observation tower could watch the many prisoners.

Much has been made about Strickland's failure at realizing the panopticon. Western State opened to just twelve prisoners in 1826 and was demolished for a do-over in 1833. Its quick dismissal does evidence that surveillance could not solely dictate satisfactory prison construction when separation and industry were also imperative. Yet the structure's architectural and disciplinary distinction from near contemporary facilities, including the Eastern State Penitentiary at Philadelphia has been exaggerated. In fact, Strickland's work also informed the Eastern State's structures. In September 1821, he shared estimates for the ongoing Western project with fellow Philadelphia architect John Haviland, then a bidder on the larger and more prominent proposed Eastern project. From Strickland, Haviland verified that even the lesser Pittsburgh facility required tons of rock. Its entrance building alone, two hundred feet wide with towers and arched gates, Strickland calculated to need 200,000 bricks and 3,000 perches of building stone.<sup>230</sup> The perch unit has had several meanings, but as a unit of volume specific to stone masonry Strickland's figure translated to more than 4,500 tons in this single facet of the Pittsburgh prison. The entrance building was the equivalent of a four-story cube of stones, some 74,000 cubic feet. Those stones,

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<sup>228</sup> Victor Bailey, "English Prisons, Penal Culture, and the Abatement of Imprisonment, 1895–1922," *Journal of British Studies* 36, no. 3 (1997): 285–324.

<sup>229</sup> Jeff Slack, Angelique Bamberg, and Clara Halderman, *Western State Penitentiary Historic Resource Survey Form* (May 2018), 92-93.

<sup>230</sup> John Haviland, "Memorandums 1822," John Haviland Papers, Vol. 1, 7, Colenda Digital Repository of the University of Pennsylvania, <https://colenda.library.upenn.edu/catalog/81431-p3mp4vv0j>.

of course, like the bricks in the entrance's arched doorways, were laid in lime mortar. Labor and materials for the entrance's masonry—stone, brick, lime, and plaster—amounted to \$11,600 or just over half its cost.

Projects like the construction of Western State might easily be viewed as only the expensive and complicated technocratic projects that they were. Strickland and Haviland's notes from the 1820s demonstrate that costs for the stone and lime masonry of an entire prison totaled many tens of thousands of US dollars, the equivalent of several million today.<sup>231</sup> Executing the construction plans required sourcing not only quarried stone and lime but also iron, lumber, copper, and more, while also marshaling the labor of scores of carpenters and smiths and shovel-wielding day laborers (sometimes the prisoners themselves) on site. The architects additionally considered not only how to support such a heavy structure but also how to impede or channel flows of rainwater, moist air, and lightning so as to best preserve the building. Amid these figures and specifications, it is easy to lose sight of these projects as an interaction between popular concepts about criminality and the masonry materials themselves. The new prisons' thick ramparts and equally robust internal walls were much more than a milestone of civil engineering. They were an experiment in letting stone control people's lives and, reformers hoped, their minds.

The Prison Society was there to remind anyone who would listen about the details of this experiment and the results they expected. Early in 1821, as the Legislature considered the terms of funding the State Penitentiary for the Eastern District of Pennsylvania, the Society restated their case for a building that would realize the full potential of separate confinement. In this petition, long-time Society president William White was joined by, among others, the Philadelphia lawyer and increasingly active penologist, Roberts Vaux.

On March 20, Pennsylvania's legislative assembly approved funding for a new prison just beyond what was then Philadelphia's northwest edge.<sup>232</sup> Copious kilned mortar and bricks and stone and slate and

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<sup>231</sup> Haviland, "Memorandums 1822," 13.

<sup>232</sup> McElwee, *A Concise History*, 5.

iron pipes—enough of it all to construct chambers that would allow in and out the minimum necessities of life and labor but were otherwise only penetrable by God’s connection to the human soul—was an expensive proposition. The Legislature appropriated \$100,000 in addition to the proceeds from selling some state-owned land in Philadelphia County.<sup>233</sup> Commissioners ultimately selected John Haviland’s architectural plan, by which scores of Philadelphia workers would soon collaborate with tons upon tons of rock and mortar to create a building that many thought would save men’s souls. The architecture was to disconnect prisoners from everything save an abstract, heavenly God and their own thoughts, which were to be interrupted sporadically and intentionally by carefully selected voices.<sup>234</sup> Visiting clergy and laity providing regular moral instruction, reformers believed, promised to pair with the structure itself in both preserving convicts from further corruption and effecting a penitence that, in turn, would recreate them as productive citizens.

Haviland’s concept for Eastern State went even further in its realization of separation than what the moral advocates for solitary confinement had precisely discussed. He proposed seven long cell blocks each radiating out from a central building room. Each cell— twelve feet long, nine feet wide, and twelve feet high—was partitioned from those adjacent by eighteen inches of mortared stone with a plaster finish. Two feet of the same materials insulated the cell space from its individual yard, a space of similar dimensions and walls to the cell but with uncovered ground below and open sky above. All walls were to extend at least three feet belowground. Underlying each cell floor was to be another eighteen inches of masonry upon which joists were laid to support an oak plank floor.<sup>235</sup> The lofty, groin-vaulted ceiling invited an upward gaze toward the cell’s circular daylight portal, a ring of iron embedded in the mortar on its outside and holding a glass lens on its inside.

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<sup>233</sup> McElwee, 6.

<sup>234</sup> Foulke, *Remarks on the Penal System of Pennsylvania*, 7; McElwee, 5.

<sup>235</sup> Haviland, "Memorandums 1822," 24.

At times, only the daylight portal and a ceramic pipe from a corner toilet pan allowed any sound, light, or matter to easily enter or leave the cell. At other times, wood-encased sheet iron doors were opened on either end of the cell to permit “the fresh air to pass freely through the buildings.”<sup>236</sup> Each cell’s sewage pipe led to a larger ceramic sewer main running below the block’s corridor. Internal glazing and hydraulic cement around joints were to make the sewer main flushable by a daily pulse of water, and air traps were to prevent smells from re-entering the cells.<sup>237</sup> The pooled water in air traps was also supposed to “prove a perfect preventative from the prisoners using them as speaking trumpets from cell to cell,” though it did not.<sup>238</sup> The plumbing would in subsequent years require fixes for that very issue.<sup>239</sup> Haviland designed barrel-vaulted ceilings for each block’s corridor. He specified that they should consist of brickwork eighteen inches thick, “the whole covered with a strong durable cement impervious to water.”<sup>240</sup>

Multiple up-and-coming architects vied for the honor of designing the compound, and any of them might have used so much cementitious material as did Haviland, the awardee. Haviland set himself apart with a design that considered the future prison’s ecosystem at every scale, essentially aiming to create the ideal habitat, as reformers had articulated it, for rehabilitating criminals. Famously, the plan included an audacious system of waste removal by which each cell had a toilet connected to a sewer before even the White House had such a thing. Other contrivances provided for providing each prisoner with food and daylight—each an experiment in complementing Eastern State’s impeding walls with a novel hands-off technology of limited ingress and egress. On a larger scale, Haviland chose the radial

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<sup>236</sup> Haviland, “Memorandums 1822,” 25.

<sup>237</sup> Haviland, “Memorandums 1822,” 26. For examples of hydraulic cement use in constructing Haviland’s designs, both for jointing pipes and for roughcasting a pebbly veneer upon surfaces, see Haviland, “Memorandums 1822,” 71; October 28, 1825, in “Day Book,” 32, Box 4, Records Relating to the Construction Of The Eastern State Penitentiary 1821-1839, Department of Corrections Record Group, PSA.

<sup>238</sup> Haviland, “Memorandums 1822,” 27.

<sup>239</sup> Samuel R. Wood, “Warden’s Report,” in *Tenth Annual Report of the Inspectors of the Eastern State Penitentiary of Pennsylvania* (Philadelphia: Brown, Bicking, and Guilbert, 1839), 11, ESP.

<sup>240</sup> Haviland, “Memorandums 1822,” 27.

arrangement of cell blocks because it “admit[ted] fresh air from every point.”<sup>241</sup> Indeed, the site on Cherry Hill, was chosen for being “one of the most elevated, airy, and healthy sites in the vicinity of Philadelphia.”<sup>242</sup> Haviland worried about the healthfulness of the buildings he designed in terms of a balance between ventilation and separation, desiring not only to prevent moral contamination but to mitigate the spread of disease among inmates. He designated much of the space between the cell blocks for “kitchen gardens” to provide vegetables consumed in the prison that while growing “would have a salutary effect on the air of the Penitentiary.” The kitchen itself, as well as a laundry room, a bakery, and related spaces for domestic-type labor were to be located adjacent the central building, where Haviland initially envisioned twenty-six additional cells for detaining female prisoners whom he assumed would perform the prison’s cooking and washing.<sup>243</sup>

The creation of this thirteen-acre managed ecosystem around the most extensive building in the United States was a minor geologic event. Workmen laid the cornerstone on May 22, 1823, in front of lead commissioner Roberts Vaux presiding over ceremonies attended by the eleven other commissioners along with Haviland, Superintendent of Masonry Jacob Souder, and many fellow laborers.<sup>244</sup> Over the following years, workers would include masons, stone cutters, and carters who were paid weekly for their exertions. Laborers hauled cartloads of foot-wide rocks—primarily gneiss, a dense product of high-pressure metamorphosis—half a mile uphill from the Schuylkill River’s edge. Lime kilners supplied, via barges as well as carts of their own, the mineral glue that held together the stones as well as the hair-laced material of plaster finishes.<sup>245</sup> In 1826, as mortar application began to peak, most of the lime came from

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<sup>241</sup> Haviland, “Memorandums 1822,” 24.

<sup>242</sup> McElwee, *A Concise History*, 6.

<sup>243</sup> Haviland, “Memorandums 1822,” 28.

<sup>244</sup> McElwee, 6.

<sup>245</sup> “Day Book,” 37; Much interior material of the original walls is visible today in the many segments that deteriorated significantly between the last correctional use in 1971 and the first attempts at preservation in the late 1980s. Visitors today may view the hairy plaster and the copious lime, as the author was able to do while being shown the structures by Elizabeth Trumbull, Senior Director of Preservation and Operations at Eastern State Penitentiary Historic Site.

either a Daniel Davis or an Andrew Crawford.<sup>246</sup> Their provisions were measured in bushels and single orders could be from 740 to more than double that many units.<sup>247</sup> Even by the most conservative estimate of the average bushel weight, the project was employing five to ten tons of lime each week at the height of construction season.

As one prison reformer later put it, “large sums have been expended for the purpose of giving an unusual degree of solidity and durability to every part of this immense structure.”<sup>248</sup> He noted the quintessential *architecture terrible* in the “grave, severe, and awful character” of an external wall twelve feet thick and the base and still nearly three thick at its thirty-foot top.<sup>249</sup> Yet just as impressive were the internal walls that so enclosed the cells with so few exceptions. To a significant degree, Eastern State’s builders and the materials themselves had realized Haviland’s plans for extreme isolation. The cells were along seven long radial corridors with “small openings, for the purpose of supplying the prisoner with food...the admission of cool or heated air, and the purpose of ventilation.” The daylight portals were in place, well beyond the reach of the incarcerated. The floors were initially wood atop stone, a surface both aesthetically and thermally warmer than the plastered and whitewashed walls and ceiling. Each cell contained a bed with mattress and bedding, a rail for hanging clothes, a chair, a shelf, a tin cup, a wash basin, a food dish, a few personal hygiene tools. The dimensions, eleven feet nine inches long and seven feet six inches wide, were larger than typical cells at the time, but this was to allow for the imprisoned to spend at least 23 hours a day therein, producing woodwork or dyed fabric or shoes without ever leaving.<sup>250</sup>

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<sup>246</sup> In the “Day Book” and other Eastern State Penitentiary construction logs, lime from each of these purveyors was recorded in the project’s receipts with a respective code (Davis, 23, and Crawford, 24), and lime had its own code in the monthly expense summaries (25).

<sup>247</sup> See for example “June 24, 1826”, “August 25, 1826,” and “Sept. 22, 1826,” in “State Penitentiary 1826,” Box 4, Records Relating to the Construction of The Eastern State Penitentiary 1821-1839, Department of Corrections Record Group, PSA; “Day Book,” 110.

<sup>248</sup> McElwee, 6.

<sup>249</sup> McElwee, 7.

<sup>250</sup> McElwee, 8.

Word about the architectural realities and reformatory ideals of Eastern State spread quickly and far. The Prison Society, and especially Roberts Vaux, soon found themselves defending the Pennsylvania system against detractors from other states and nations. In fact, in 1827, the building's construction yet ongoing, Vaux found himself penning a letter to William Roscoe, a retired Liverpool banker and fellow advocate of prison reform. In it, Vaux corrected what he viewed as misinformation contained in a pamphlet that Roscoe had written. The pamphlet had charged Pennsylvania penitentiaries with being no less miserable than the Bastille or chambers once abusively employed by the Spanish Inquisition. Solitary confinement affronted Christian benevolence, Roscoe asserted, and among punishments was "the most inhuman and unnatural that the cruelty of a tyrant ever invented."<sup>251</sup> Vaux's rebuttal focused on Roscoe's apparent misunderstanding of Eastern State's ecosystem. The cell blocks were fire-proof, the cell dimensions were generous, they were all aboveground, "judiciously" supplied with daylight and heat and fresh water for drinking or washing, and each opened onto an even larger airy yard. How, Vaux wondered, could Roscoe question the Christian benevolence in such a carefully curated environment? This reply appeared in the *National Gazette*, a Philadelphia publication with many regional syndicates that was dedicated to discussing scientific developments and their policy implications.

Eastern State had become a lightning rod for deeply held beliefs about the intersection of reform, architecture, and discipline practices. Government officials from "Great Britain, France, Russia, and Belgium" arrived to view the place as "a remarkable example of reform." The building itself had become an actor in prison reform history. Visiting the structure was at least as important as gathering portable information about how it had been constructed or how it was operated.<sup>252</sup>

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<sup>251</sup> Roberts Vaux, *Letter on the Penitentiary System of Pennsylvania* [Addressed to William Roscoe, Esquire, of Toxteth Park, near Liverpool] (Philadelphia: Jesper Harding, 1827), 7.

<sup>252</sup> Foulke, *Remarks on the Penal System of Pennsylvania*, 8.

In 1828, Edward Livingston wrote a letter to Roberts Vaux that the *National Gazette* also published and distributed.<sup>253</sup> Livingston was then consulting on the development of Louisiana's penal code. A devotee of Eastern State's isolating structure and practices—together referred to as the Pennsylvania System, he was frustrated by the resistance to its full replication elsewhere. Officials in Louisiana understood other systems to be less expensive and yet also successful, like the system of silent congregate labor with nightly isolation associated with the prison at Auburn, New York, or the system of solitary confinement without labor. But Livingston believed that the success of Auburn was only relative to the extreme lack of spatial organization in Louisiana's existing prisons.

Livingston's letter to Vaux drew a direct rebuttal in 1829 from Gershom Powers, a New York official involved in the administration of the silent system at the Auburn Prison, opened in 1818. Their exchange initiated a decades-long public debate over the relative merits of what came to be termed the Pennsylvania System and the Auburn System. Auburn was largely an attempt to blend the industrial productivity developed at New York's older Newgate prison with the solitude of Eastern State.<sup>254</sup>

Yet in retrospect what is salient are the similarities between the two systems.<sup>255</sup> Taking into account what prisons truly were in their substance, the indiscriminating effects of a cellular environment upon the incarcerated, and the variety of guard behaviors that people could experience in either facility, Auburn and Eastern State were more alike than different. Powers emphasized the separation that Auburn's cells produced, thanks to material changes implemented during a 1819 renovation that followed a fire set intentionally by convicts.<sup>256</sup> He accepted Livingston's terms of debate by sharing the specifications for

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<sup>253</sup> *Letter from Edward Livingston, Esq., to Roberts Vaux, on the Advantages of Pennsylvania System of Prison Discipline* (Philadelphia: Jesper Harding, 1828), MHS.

<sup>254</sup> Lee Bernstein, "Sintsincks to Sing Sing: Empire, the War of 1812, and the Transformation of US Prisons," *Early American Studies: An Interdisciplinary Journal* 20, no. 2 (2022): 339-369.

<sup>255</sup> I am not the first to come to this conclusion. See, for example, historian of technology W. David Lewis' argument that officials at New York sites aimed to "so completely cut off [the convict] from his fellows as to be incapable of corrupting them or of being the recipient of evil influences" (Lewis, *From Newgate to Dannemora*, 53).

<sup>256</sup> *Livingston to Vaux*, 1828, 6.

thickness and material of cell construction and explaining any variances.<sup>257</sup> Powers, and the many other New York officials who signed the letter in concurrence, also appeared to agree that moral reform as demonstrated by the convict's penitence and return to righteous industry was ultimately more important than retribution. To that end, they presented a seven-page table of prisoners' "character before conviction" and "character since discharged" to bolster their defense of Auburn.<sup>258</sup>

The experience of overnight isolation and silent diurnal congregation at Auburn seems to have truly been more like the round-the-clock isolation at Eastern State Penitentiary than was sometimes pretended. The penitentiary's structural separation was never perfectly realized, as proponents of rival prisons like Auburn were quick to note.<sup>259</sup> The cracks, both literal and figurative, in the separation plan were large and small, human and non-human. There were always logistical issues to totally isolating prisoners, who occasionally needed more than daily food, removal of their bodily excretions, and warm air during the winter—serious medical attention, for example. Documented rules and consequences reveal that even cautious practices of staggered exercise yard use did not keep prisoners from occasionally throwing objects over yard walls or yelling out, if someone was willing to risk punishment in an effort to make verbal contact. Water vapor found its way into cells but could not find its way out, instead condensing on the surfaces of cold stone walls.<sup>260</sup> Sound traveled easily through each cell block's long central corridor, bouncing along the plastered hall between its vaulted ceiling and paved floor. This was an intentional feature, which visiting clergy used for sermonizing from the head of the cell block corridor. But it also meant a guard's stumble, his jolting closure of a door, and likely even a whisper could be heard throughout the block. The corridor's soundscape differed from cells themselves, where wooden flooring and bedding materials provided some acoustical dampening. The feeding holes, even when closed, were

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<sup>257</sup> *Livingston to Vaux*, 1828, 37-39.

<sup>258</sup> *Letter of Gershom Powers, Esq., in Answer to a Letter of the Hon. Edward Livingston, in Relation to the Auburn State Prison*, (Albany, NY: Croswell and Van Benthuysen, 1829), 46-52, MHS.

<sup>259</sup> Frederick A. Packard, *A Vindication of the Separate System of Prison Discipline from the Misrepresentations of the North American Review* (Philadelphia: J. Dobson, 1839), 5-6, LCP.

<sup>260</sup> Smith, *A Defence of the System*, 32.

therefore literal holes in the plan to completely seal off prisoners and leave them alone with their thoughts.

### Penitentiaries Become Contentious, but Cement Sticks

During the four decades between the opening of Pennsylvania's Eastern State prison and the call for bids on building Montana's first territorial prison, high-quality mortar had clearly come to be seen by many experts as an essential component of prisons. Moreover, as Americans developed new cement sources and kilning practices, cement became an entire realm of technology within which prison architects could specify the meaning of terms like "high-quality." Even though the state later decided the material was too costly, Montanans clearly understood that hydraulic cement was the new ideal for modern prisons. During the same period, from 1830 to 1870, Eastern State remained a focal point of intense public discussion about the architecture and use of modern prisons. Underlying the debate were questions of what cell walls did to the people stuck inside them and whether this was crucial to reforming criminals or whether it was too much, perhaps even counterproductive. Indeed, the relationship between state prison officials and evolving masonry technologies entailed a fascinating negotiation between a seemingly passive and instrumental material world and more complex and abstract concepts of justice. To participate in those negotiations, many public officials and interested citizens took a heightened interest in what exactly was occurring within the many walls of a place like Eastern State Penitentiary. As some defended isolation as a temporary detriment that was necessary for reform and others charged that it with permanent mental debilitation, the nature of the walls themselves was never far removed from discussions of the nature of the human beings they contained.

Charles Williams was one of nine convicts admitted to Eastern State in 1829. By the end of 1834, another 337 had been incarcerated there, of which 218, all but one of them male, remained. Of those who left, ninety-three had completed their sentence, thirteen received pardons, five escaped, and fifteen

died.<sup>261</sup> Some of the most ardent reformers decried this disproportionate conviction and imprisonment of males, for which one blamed “the misplaced and criminal sympathy of courts and juries.” He added, “This evil should be corrected—sex or condition should not sanctify crime.”<sup>262</sup> Non-white convicts were also a disproportionate population within Eastern State from the beginning. Prison records in 1833 identified twenty-two of the seventy-seven admitted as “colored,” a percentage of non-whites ten times greater than what the 1830 census had identified for Pennsylvania’s general population.<sup>263</sup> Likewise overrepresented were those who had not been born in Pennsylvania but had come there by immigration or by escaping slavery in the South.<sup>264</sup> Total expenditures for the building could no longer be accurately tallied, but ten different State appropriations amounted to some \$673,000 and the state-approved properties had yielded another \$99,476.60 for the project. In 2024 dollars, nearly \$27.7 million had been documented, and many were convinced that untraceable additional sums had been spent in addition to unsanctioned use of free convict labor.<sup>265</sup> Eastern State had 311 cells and construction continued on track to reach the goal of 650.<sup>266</sup>

All was perhaps not well, however. In late 1834, a ten-member committee of Pennsylvania legislators undertook to make a critical review of the facility. The State was investigating the Warden Samuel R. Wood and several other officers and their family members, for “abuses said to have been committed in the economy and management” of the penitentiary.<sup>267</sup> The committee corroborated many of the charges, and read their report to the Pennsylvania House of Representatives on March 26, 1835. The committee called the topic a matter of “national honor and reputation, [Eastern State] commanding as it

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<sup>261</sup> McElwee, 23

<sup>262</sup> McElwee, 26.

<sup>263</sup> Percentage non-white population of Pennsylvania calculated as “Total free colored” plus “Total slaves” divided by “Total population of Pennsylvania,” as found in *The Clerk of the House of Representatives, Abstract of the Returns of the Fifth Census* (Washington, DC: Duff Green, 1832), 13.

<sup>264</sup> McElwee, 27.

<sup>265</sup> McElwee, 9-10.

<sup>266</sup> McElwee, 8.

<sup>267</sup> McElwee, 3.

does the admiration of the whole civilized world.”<sup>268</sup> The five categories of abuses indeed threatened reputations. The first charge was indecent relations, including sexual intercourse and sexual transmission of disease, “generally known to and participated in by the Warden, one John Holloway, one Richard Blundin and his wife, and others unknown.”<sup>269</sup> The second charge was embezzlement and misapplication of public funds.

The committee had spent the most time, however, on allegations three through five, which in various ways described the warden and his staff as “defeating the regularity and precision which ought to characterize the penitentiary system.”<sup>270</sup> The committee shared their findings in hopes of resetting a staff culture that would have “the least interference with the system of solitary confinement.” Such misdeeds had included wanton actions like allowing prisoners out of cells to perform personal assistance or holding loud social gatherings within the premises. Officials were also punishing prisoners in unsanctioned ways: deprivation of yard time, withholding of meals, or using bindings and gags. On occasion, staff sent prisoners to “The Dungeon,” a cold and bedless cell from which light was entirely excluded. Those coming out of it continued to suffer rheumatism among other lingering physical and psychological effects.<sup>271</sup>

Solitary confinement had been meant to replace these tortures. In reasserting how unnecessary, illegal and inhumane such punishments were, committee member Thomas McElwee pointed to the cases of William Griffith, an Eastern State keeper, and William Napier, an infamous robber who was prisoner No. 50. Griffith found Napier to be gaming the system, putting on pious airs in front of the Inspectors and then working slovenly while claiming to have compromised vision in one eye. The Warden allowed Griffith to deal with this as he liked, and instead of turning to torture, Griffith reset the solitude by taking

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<sup>268</sup> McElwee, 29.

<sup>269</sup> Mr. Anderson, of Delaware, reporting on behalf of the joint committee, in McElwee, 34.

<sup>270</sup> Mr. Penrose of Cumberland, *Report of the Joint Committee of the Legislature of Pennsylvania, Relative to the Eastern State Penitentiary* (Harrisburg, PA: Welsh & Patterson, 1835), 44, LCP.

<sup>271</sup> McElwee, 16-18.

away Napier's tools and books and restricting visits to Napier's cell. After one week, McElwee reported, Napier had admitted to lying about his vision and was pleading for his labor again. But Griffith ignored the pleas for another two weeks, after which Napier had his tools restored, "pursued his work with unusual industry," and never complained again.<sup>272</sup> McElwee shared Livingston's earlier assessment of how potent the sensory austerity in these cell environments could be, and Griffith's tactful use of the structural isolation as sole punishment made him a righteous keeper in their minds. The same could not be said for other staff. In their cases, the penitentiary's human component was interfering with or even negating the moral benefit of its structural components.

McElwee authored his own minority report, which he published in a personal recapitulation of the affair. For an epigraph to the volume, he chose: "I would not enter on my list of friends, Tho' grac'd with polished manners and fine sense, Yet wanting sensibility, the man who needlessly Sets foot upon a worm." Even when McElwee used the term *punishment*, he meant a process by which an individual was reformed to productive life. He understood this to be a kindness. He contrasted "the punishment of privation, solitude, and labour for a certain time for a specified offense" the Society had advocated with the simple "restraint" of individuals that other jails afforded. McElwee praised William White and Roberts Vaux as having "laboured unceasingly to promote the happiness of their fellow beings."<sup>273</sup> Even as he expressed disgust with the lack of accounting for expenditures to-date and the opportunity that created for wasting money, he never challenged Pennsylvania's need for such an expensive structure of separation.<sup>274</sup> As much as any committee member, McElwee faulted the keepers for extraneous tortures and personal indulgences that he contended made Walnut Street's practice of solitary confinement better than Eastern State, atrociously wasting the latter structure's potential.<sup>275</sup>

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<sup>272</sup> McElwee, 19.

<sup>273</sup> McElwee, 5.

<sup>274</sup> McElwee, 10.

<sup>275</sup> McElwee, 21.

The committee, and McElwee more than others, generously seasoned their reporting with more defense of the Pennsylvania system, in apparent distinction from the other prison systems then popular. “Our system requires not only labor, but solitude, which, combined, are calculated to bring about reflection upon past misdeeds, and their evil consequences,” McElwee wrote. Though they varied on the question of whether solitary confinement alone could create obedient prisoners, they agreed on the importance of distinguishing from Auburn and Sing Sing, where guards regularly deployed corporal punishment by whipping and beating to enforce silence even in congregate situations.<sup>276</sup> That division, between the Pennsylvania separate system and the congregate but silent system, had some realities. However, the true distinction was exaggerated. No matter how exactly solitary confinement was used, all of the prisons were fabricated structures that effected extreme degrees of separation. They all informed the general consensus that separation had significant and beneficial power to society.

Having examined the building, interrogated the staff, and witnessed the prisoners, the committee remained convinced of Eastern State’s reforming potential.<sup>277</sup> Cellular segregation, they maintained, did offer the convicted person a third route aside from capital punishment or the “hopeless infamy” of publicly shamed thieves. They still entrusted the penitentiary environment “to present to him motives to return to the paths of virtue,” motives that appropriately balanced “the vengeance of the law” with “its mercy.”<sup>278</sup> Specifically, they yet believed “the profound and noiseless solitude of the penitentiary cell” would cause sorrowful reflection, forcing the criminal’s mind to “be thrown back upon itself, and left without that delusive prop which wicked men derive from intercourse with their fellow men.”<sup>279</sup> Most of the committee, however, agreed that the Warden needed some discretion in relieving at least some

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<sup>276</sup> Mr. Anderson, of Delaware, reporting on behalf of the joint committee, in McElwee, 41.

<sup>277</sup> Among the materials that McElwee compiled and published along with his minority report was a date log of the joint committee’s efforts, including multiple visits they made to Eastern State’s interior. See for example January 22, 1835, on which the committee “made a personal examination of the penitentiary, and the prisoners confined therein,” McElwee, 102.

<sup>278</sup> Mr. Anderson, of Delaware, reporting on behalf of the joint committee, in McElwee, 46-47.

<sup>279</sup> Mr. Anderson, of Delaware, reporting on behalf of the joint committee, in McElwee, 50.

prisoners from strict solitary if the system was to realize its long-term potential. They had heard the critics who said Eastern State's configuration and the use of its structures went too far in depriving people of movement and sensation, far enough to risk permanently debilitating those who were supposed to be rehabilitated.

At the same time, the committee worried that discrepancies in prisoner treatment opened the door for convicts to game the system.<sup>280</sup> Similarly, they all agreed with Dr. Francis Lieber, the noted philosopher of ethics in legal and extralegal settings, as well as Eastern State's recent French visitors Gustave De Beaumont and Alexis De Tocqueville, and a Mr. Dermont, reporter to a recent council at Geneva, that the system by which convicts could pardons were bad.<sup>281</sup> According to committee chair Samuel Anderson, many convicts were fixated on receiving a pardon from Pennsylvania's governor. Anderson quoted Dermont, who had written "everything which diminishes the certainty of punishment is evil: every punishment which is not fixed, which floats between fear and hope, is a punishment badly contrived."<sup>282</sup> The Legislature's supplemental act in response to the report did not remove pardons but did make them a more rigorous procedure involving more than a simple, unilateral decree.

Lieber, who would later become famous for writing the first ethical guidelines for the military's treatment of civilian non-combatants during the Civil War, threw himself into similarly complex ethical questions regarding penology. He published an English translation of De Beaumont and De Tocqueville's review of American penitentiaries and began writing his own defenses of the Pennsylvania system. In one, he articulated anew Eastern State's intents and justifications. "Solitude with labor," he wrote, "prevents contamination" by fellow prisoners or by other temptations and afflictions present in environments they previously knew, creates "a most powerful moral medicine" in the form of forced reflection, and "affords a kind of punishment which... avoids all excitement in the criminal, and does not

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<sup>280</sup> Mr. Anderson, of Delaware, reporting on behalf of the joint committee, in McElwee, 49.

<sup>281</sup> Gustave de Beaumont and Alexis de Tocqueville, *On the Penitentiary System in the United States, and its Application in France*, trans. Francis Lieber (Philadelphia: Carey, Lea & Blanchard, 1833).

<sup>282</sup> Anderson, in McElwee, 55-56.

irritate anew him who considers himself already at war with society.” Most criminals, Lieber believed, had “become such from thoughtlessness,” and therefore simply needed to spend time inside a structure that would force thoughtfulness upon them.<sup>283</sup> Lieber’s trust in the controlled walled environment of the prison allowed him to grant these convicts a benevolence that was absent in his later justification of punishing or even executing civilians who had aided the enemy. The convict, though also “at war with society,” was contained to a degree that sharply contrasted with non-combatants spread across landscapes in the Civil War.

By 1838, Francis Lieber was president of the private Prison Society whose efforts at reform had often failed in the past. Now Lieber used his position to routinely deliver full-throated defenses of Eastern State along with takedowns of any other systems for punishing the criminally convicted. He was among the most staunch and influential supporters of cellular separation and gave lengthy enumerations of its salutary effects. Lieber also had an arsenal of responses to the increasingly common charges that loneliness was cruel punishment, responses grounded by the notion that people operating with a so-called criminal character were so distinct from “morally healthy ones” as to require correction that was unusual not only in degree but in variety.<sup>284</sup> He thought those who pitied inmates “desolation,” as one woman put it, were not being rational, even though many who voiced such concerns also believed in Eastern State’s rehabilitating powers enough to volunteer as moral instructors there.<sup>285</sup> Lieber only noted a few negatives of cellular separation, and among those he only gave much credence to the indisputable fact that building the many thick and necessary walls was more expensive than the alternatives.<sup>286</sup> This would indeed remain the common sticking point for modern prison construction, with costs only increasing as the

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<sup>283</sup> Francis Lieber to Charles B. Penrose, Chairman of the Committee of Inquiry into the Affairs of the Eastern Penitentiary, Philadelphia, January 22, 1835, as printed in McElwee, 60-68.

<sup>284</sup> Francis Lieber, *A Popular Essay on Subjects of Penal Law, and on Uninterrupted Solitary Confinement as Contradistinguished to Solitary Confinement at Night and Joint Labor by Day* (Philadelphia: E.G. Dorsey, 1838), 69-74, MHS.

<sup>285</sup> *An Address by a Recent Female Visiter [sic] to the Prisoners in the Eastern Penitentiary of Pennsylvania* (Philadelphia: Joseph and William Kite, 1844), LCP.

<sup>286</sup> Lieber, *A Popular Essay on Subjects of Penal Law...*, 61-68.

demands for materials became more specific—including the qualities of cement for mortar and floor surfacing.

From the late 1820s and well into the 1840s, discourse on prison theory continued to proliferate among what Bert Vanhulle, a historian of Belgium’s prison system, has called “semi-official penology specialists.” As the relationship between Lieber, De Beaumont, and De Tocqueville demonstrates, these semi-official penologists constituted a transatlantic intellectual society whose members often had access to government funding and means of publication. Several historians, including Vanhulle, have pointed to how far the members’ modern penal ideals launched into an abstract discourse about granular penitentiary discipline and, at the same time, nationwide prison uniformity. Many of their common claims, like that solitary confinement was a stronger deterrent than execution, went unevidenced. Meanwhile, prison construction continued apace, and staff ignored or even resisted the semi-official penologists’ input as they managed life inside the new structures.<sup>287</sup>

While the semi-official penologists of course did not manipulate the day-to-day behavior of people within prisons, they *did* significantly influence the design and construction of prisons and, by extension, the environment incarcerated people experienced. In the United States, they shaped an increasingly homogeneous prison construction regime across the Northeast that soon became the standard throughout the whole nation.<sup>288</sup> On both sides of the Northern Atlantic, amateur penologists visited every state prison and participated to the utmost in the composition of each new facility. Though not all

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<sup>287</sup> Bert Vanhulle, “Dreaming about the prison: Édouard Ducpétiaux and Prison Reform in Belgium (1830-1848),” *Crime, History & Societies* Vol. 14, no. 2 (2010): 107-130.

<sup>288</sup> William D. Williamson, J.R. Abbot, and Nathaniel Clark, “Report of the Commissioner of State Prison to the Governor and Council of the State of Maine” (January 22, 1836) and Sherman Leland, “Documents Relating to the [Massachusetts] State Prison” (1834) in *Reports on Prisons – Vol. 2*, HV8358.R47 v.1, Kislak Center for Special Collections - Rare Book Collection, University of Pennsylvania. “An Act concerning the government and discipline of the Penitentiary in the District of Columbia,” *The New Hampshire Gazette* (Portsmouth), June 2, 1829, 1; “State of Rhode Island and Providence Plantations,” *The Rhode-Island Republican* (Newport), March 26, 1834, 4; “An act providing for the Regulation and Government of the State Prison,” *Lancaster (MA) Gazette*, May 6, 1828, 1.

behavior in prisons was new, the number of prisons and the qualities of prison environments were, in fact, changing.

Other tangible changes during the 1830s involved the record keeping and treatment of apparent “mental disorders” in convicted persons. Such record keeping at Eastern State became especially visible in the Board of Inspectors’ 1838 report, and it evidenced underlying questions about the relationship between psychology, criminality, and the penitentiary cell’s extreme isolation. The inspectors applauded the Pennsylvania legislature’s “benevolent effort” in planning an “Insane Hospital.”<sup>289</sup> They regarded several people at Eastern state to have been “insane at the time of the commission of their crimes,” and hoped the new institution would make those convicts the last to endure the fate of solitary confinement while insane. “A penitentiary is not a suitable place for the care and management of lunatics,” they were sure.<sup>290</sup>

Less certain was whether solitary confinement was causing insanity. Answering that question was complicated by contemporary notions about what type of disease insanity was and how it was brought about. Structural separation seemed a general prophylactic against contagions like smallpox, but mental disorders were perhaps not contagions.<sup>291</sup> At least not all of them. Eastern State officials described insanity and equivalent conditions of “mania,” “monomania,” or “hallucination,” as related to but importantly distinct from both “chronic” and “acute” dementia.<sup>292</sup> During 1838, officials kept a detailed table of “Mental Disorders in the Eastern Penitentiary,” carefully divided into White Prisoners and Coloured Prisoners. A timescale of months was plenty for an entire story of mental health to play out.

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<sup>289</sup> For more on the coincident development of prisons and mental health institutions in the United States, see David J. Rothman, *The Discovery of the Asylum: Social Order and Disorder in the New Republic* (Boston: Little, Brown and Company, 1971). For related case studies from France and England as precedents to US developments, see Michel Foucault, *Madness and Civilization: A History of Insanity in the Age of Reason*, trans. Richard Howard (Routledge Classics, 2001).

<sup>290</sup> Inspectors T. Bradford, J. Bacon, R. Patterson, M. Bevan, & W. Hood, *Tenth Annual Report of the Inspectors of the Eastern State Penitentiary of Pennsylvania*, 7.

<sup>291</sup> Bradford et al., *Tenth Annual Report*, 15.

<sup>292</sup> Bradford et al., *Tenth Annual Report*, 17.

Officials captured those narratives, however loaded their secondhand accounts may have been. For instance, prisoner No. 661, a white twenty-year-old native Pennsylvanian, was admitted in “Good” health. However, he soon displayed monomania, which officials, as was common, blamed on the prisoner’s masturbation.<sup>293</sup> His mental ailments “relieved to a degree” before, ten months into his imprisonment, he developed a case of consumption that ended his life.

The 1838 table showed seven other White Prisoners developed various mental disorders during the year. All ten mental ailments on the Coloured Prisoners side were “Dementia, acute,” and all of them were both attributed to masturbation and deemed cured or relieved.<sup>294</sup> While Eastern State officials associated “manias” with apparent individual circumstances and choices including self-pleasure, they were careful to use less pathologized terminology for the mental conditions to which they readily credited the cellular structure itself. In their reports, phrases like “subdued in feeling” or “tormented by their own reflections” described a necessary step toward reform if also a depression caused by the structural separation that people endured.<sup>295</sup>

With the effects of solitary still hotly debated, construction of new prisons with thoroughly separated cells nonetheless moved forward. John Haviland found plenty of opportunity to continue developing isolating penitentiary architecture elsewhere in Pennsylvania. In 1840, he began overseeing construction of the new Dauphin County Jail in Harrisburg. Haviland began to work with a new, more malleable concoction as a novel high-tech improvement on the dense stone that Eastern State had employed by the cartload. Along with conventional masonry, carpentry, and plastering, the Dauphin County facility included enough concrete to make a solid cube with dimensions of twenty feet as well as a

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<sup>293</sup> For more on the Early Modern medical phenomenon of associating masturbation with insanity, see E. H. Hare, “Masturbatory Insanity: The History of an Idea,” *Journal of Mental Science* 108, no. 452 (1962): 1–25; James Whorton, “The Solitary Vice: The Superstition That Masturbation Could Cause Mental Illness,” *The Western Journal of Medicine* 175, no. 1 (2001): 66–8.

<sup>294</sup> Table of Mental Health Disorders, appended to *Tenth Annual Report of the Inspectors of the Eastern State Penitentiary of Pennsylvania*.

<sup>295</sup> Bradford et al., *Tenth Annual Report*, 5–6.

complementary “liquid mortar” used to fill in gaps.<sup>296</sup> Here, at last, the architect revealed the importance of the cementitious materials to cellular prison architecture. Haviland at once exhibited a development in use that allowed for effective prison surfaces without as much stone mass as Eastern State had entailed.

Sourcing enough high-quality lime to effect a Haviland prison was a very serious matter. Local carpenter Peter Bernheisel stepped into the role of lime agent, working under the general contractor to ensure this crucial material arrived on site in ample quantities.<sup>297</sup> Among the three suppliers from whom Bernheisel purchased the most lime was Robert Bryson, a Harrisburg area resident who acted as both a merchant and a sort of entrepreneurial, scientific gentry farmer.<sup>298</sup> Bryson’s lime making was just part of his broader ongoing schemes to apply industrial products as soil additives.<sup>299</sup> With the number of dedicated cement makers still miniscule, jail construction still involved temporary devotion from generalist lime kilns like Bryson’s. Even so, the Dauphin County project demonstrates key developments in the iterative process of mortars and concrete sealing up prison spaces and novel built environments informing penal ideals.

As these new environments proliferated throughout the northeastern United States, their visitors came to include more than only officials, members of the amateur penology community, and volunteer moral instructors. Dorothea Dix, having surveyed prisons up and down the Atlantic Coast, strongly disapproved of the several that took in revenue by charging an admission fee of up to twenty-five cents to just anyone who was curious about the inside.<sup>300</sup> But allowing so many new guests also fueled questions about what exactly these new environments were doing to the incarcerated. Some visitors to the new penitentiaries were horrified to witness people, as one put it in 1844, “shut up...in a cold stone cell of

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<sup>296</sup> “300 perches of Concrete at 1.50 per job” from “Memorandum Book,” 6, Vol. 6, John Haviland Papers, 1806-1868, Ms. Coll. 176, KC. Description of what Haviland means by “concrete” in the same, 10-11.

<sup>297</sup> “Memorandum Book,” 65, 70, Vol. 6, John Haviland Papers; “Articles of agreement made this twenty-fifth day of June A.D. 1840,” 1, Vol. 7, John Haviland Papers, 1806-1868, Ms. Coll. 176, KC.

<sup>298</sup> “Harrisburg Pa., June 10, 1840,” 24, Vol. 8, John Haviland Papers, 1806-1868, Ms. Coll. 176, KC.

<sup>299</sup> “A New Manure,” *Sunbury (PA) American*, July 21, 1849, 4, CA.

<sup>300</sup> Dorothea Dix, *Remarks on Prisons and Prison Discipline in the United States*, 2<sup>nd</sup> ed. (Philadelphia: Joseph Kite & Co., 1845), 10.

narrow dimensions.”<sup>301</sup> This led to a fresh round of questioning the healthfulness of solitary confinement, including but now going beyond the topic of insanity among the convicted.

Prison physicians, including Dr. Edward Hartshorne at Eastern State, felt compelled to broadcast corrective statements to the public.<sup>302</sup> Hartshorne, perhaps aware of the deleterious psychological effects but intent on defending his employer, steered health conversation toward what the walls *afforded* inmates in terms of protection from damp airs, cold winds, and other “atmospheric change.” He claimed that cellular separation was also limiting spread of disease among inmates, and that those with an illness had surely contracted it in the unhealthy environments that were perhaps also responsible for their criminality. In truth, contagions spread among the imprisoned despite structural separation, which is no surprise given the shared contacts with guards, food preparers, and others as well as the prison’s overall encasement that hampered ventilation. And in talking up walls’ protective powers, Hartshorne gave no account of Eastern State’s abundant diagnoses of rheumatism, such a capacious category of health issues that it may have included not only cases of contagious disease but also symptoms caused or exacerbated by the restrictive prison environment.<sup>303</sup>

Rare as they were, pregnancy and childbirth were a particularly confounding health issue for those who promoted solitary confinement. One journalist, looking into the matter in 1844, found that the “law is entirely silent on the subject” of what to do when a child is born in prison.<sup>304</sup> The question quickly opened up onto the difficult matter of whether a mother should be separated from any children when incarcerated, which was very likely one reason for the ongoing prison gender disparities that McElwee

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<sup>301</sup> “Prison Sketches, No. 1” from the *Portsmouth (NH) Journal*, 1844, in “Prison Reform Scrapbook,” 1843-1857, Ms. Coll. 1187, KC.

<sup>302</sup> “Insane Convicts” (MA), “The Prison System in France” in *The Pennsylvanian*, and a report by Edward Hartshorne, Eastern State Penitentiary physician, all in “Prison Reform Scrapbook.”

<sup>303</sup> William Darrach, “Tabular View of the Medical Cases of Coloured Prisoners occurred in the Eastern Penitentiary of Pennsylvania during the Year 1841” and “Tabular View of the Medical Cases of White Prisoners occurred in the Eastern Penitentiary of Pennsylvania during the Year 1841,” Medical Cases of Prisoners 1841, Box 1, Prison Population Records, Department of Corrections Record Group, PSA.

<sup>304</sup> “Prison Discipline,” March 7, 1849, in “Prison Reform Scrapbook.”

had lamented years before. At the same time, in untried prisoners received at Philadelphia's county facility, the gender gap had narrowed remarkably and was virtually gone among those labeled "Colored," though it is unclear whether untried females were typically detained in similar durations to males.<sup>305</sup>

The case of one female, called a "yellow mulatto," who was in fact sentenced to Eastern State became proof to many of the new penitentiaries' rehabilitating potential. Prison Society members spread the word about this young woman, seventeen when she was sentenced, said to have embraced her time in a "light and neat" room at Eastern State, where she had learned to read, write, and pray.<sup>306</sup> Buoyed by such accounts, through the 1840s states in the Northeast continued building out their state and county prison systems with Eastern State's structure as a model. Indeed, new prisons could now draw condemnation when they did not include solitary cells.<sup>307</sup> When the first international prison congress convened at the free city of Frankfurt in 1845, representatives from the United States, England, France, Italy, Prussia, and a few smaller countries were quick to adopt a resolution "favoring cellular imprisonment."<sup>308</sup> This did not necessarily dictate strict solitary confinement, but it did promote structures that matched Eastern State's penitentiary separation.

With new, cellular prisons spreading not only in the United States but around the world, Philadelphia and New York were no longer the outside centers of penal reform they had long been. By 1846, reformers in Boston had been carrying on their own Prison Discipline Society for two decades.<sup>309</sup> Only in that year, however, did they drop their admittedly partisan cheerleading for the Auburn System and their vituperation of the Pennsylvania System. The change followed a visit to Eastern State by six

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<sup>305</sup> "City Items," a table showing the monthly numbers of persons received by Philadelphia County Prison during the year 1843, in "Prison Reform Scrapbook."

<sup>306</sup> Francis Lieber, "The Prisons of Our Country," September 18, 1843, in "Prison Reform Scrapbook."

<sup>307</sup> "The New Prison of Columbia County," *Danville (PA) Democrat*, August 27, 1847, in "Prison Reform Scrapbook."

<sup>308</sup> C.D. Randall, *The Fourth International Prison Congress, St. Petersburg, Russia* (Washington, DC: Government Printing Office, 1891), 33, MHS.

<sup>309</sup> *First Annual Report of the Board of Managers of the Prison Discipline Society, Boston, June 2, 1826*, 6<sup>th</sup> ed. (Boston: Perkins and Marvin, 1830).

delegates of the Boston Society. Samuel Gridley Howe, the abolitionist physician and a society member, reported on the visit in a broader consideration of prison systems. The delegates had been impressed by Eastern State's cells, which they thought were better called "rooms" due to their size, the comfort from drafts and moist air, the cleanly whitewashed walls, and the astoundingly advanced structural mechanisms such as heating by hot water in metal tubes or effective lighting by a small but well-made skylight.<sup>310</sup>

Likely distracted from the practice of solitary by what remained an elegant building with cutting-edge sanitation, the delegates dropped the charges of inhumanity that many Bostonians had previously joined in leveling against the separate system. They concluded that Pennsylvania's system of absolute solitary and Auburn's system of solitary by night and silent congregant labor by day were not so different. In fact, they reported, lingering arguments must have been "all the warmer" because the "ground between the disputants was so narrow."<sup>311</sup> Revelations that most modern prisons were quite similar in structure and therefore in effect, despite noted differences in disciplinary procedures, were becoming common. On this point, Howe's 1846 report to the Boston Society echoed Dorothea Dix's 1845 remarks that had emphasized the similarity of new prisons with their high degree of internal separation.<sup>312</sup>

The Boston Society members had been converted to believers in the need for structural separation of prisoners in order to produce in each a "crisis" of solitude that "softened" him and allowed that he "may be molded into a new shape."<sup>313</sup> Specifically, Howe wrote that heavy walls were a tangible reconstruction of "the dark valley of the shadow of death" through which God might lead each troubled soul, while at once being the guardrails that would physically ensure that spiritual passage toward each person's renewed character and "self-control."<sup>314</sup> Convinced of the benefits of prolonged solitary

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<sup>310</sup> Samuel Gridley Howe, *An Essay on Separate and Congregate Systems of Prison Discipline* (Boston: William D. Ticknor and Company, 1846), 4.

<sup>311</sup> Howe, *An Essay on Separate and Congregate Systems of Prison Discipline*, 1846, 7-8, 18, 29-30.

<sup>312</sup> Dix, *Remarks on Prisons and Prison Discipline in the United States*, 6-7.

<sup>313</sup> I use male pronouns because it is clear that, in these hypothetical and idealized writing about prisoners, the writers are gendering each imagined prisoner male unless they say otherwise.

<sup>314</sup> Howe, *An Essay*, 37-41, 55.

confinement, the Bostonians confronted that one intransigent drawback that Lieber had conceded: the cost. They also noted a complementary requirement to the expense of building structural separation, which was the technical wherewithal needed to effect it well.<sup>315</sup> Still, this initial hurdle seemed to them worth the trouble, because on the other side was what they understood to be the relatively simple operation of the separate system. The structure itself could replace human labor, lessening the intensity of guard work if not also the number of guards each facility needed to employ.<sup>316</sup> This was like Bentham's panopticon, both in that the material design was imagined to facilitate efficient staff labor and that it functioned better in theory than in practice, as tasks such as serving food were more involved in a solitary system. Nonetheless, the walls of single-occupant cells were doing significant work, breaking down the psychic unity and resistance of the prisoner so it might, advocates hoped, be rebuilt to the society's desired standard.

Though some skeptics of solitary were experiencing conversions, others were asking the most pointed questions yet about what separation did to a prisoner's health. Available evidence was mounting by 1849, when Pennsylvania lawyer and publisher of religious instruction materials Frederick Packard compiled the views of several doctors in a volume with the telling title, "An Inquiry into the Alleged Tendency of the Separation of Convicts, One from the Other, to Produce Disease and Derangement."<sup>317</sup> So far as communicable diseases went, Packard compiled statements on health data from Eastern State's first two physicians, Franklin Bache and William Darrach, who emphasized that in the prisons' first decade relatively few prisoners contracted respiratory diseases or infections after admission.<sup>318</sup> These apparent benefits of extreme isolation stood against apparent detriments of disease at Eastern State

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<sup>315</sup> Howe, 17.

<sup>316</sup> Howe 35-36.

<sup>317</sup> Frederick A. Packard, *An Inquiry into the Alleged Tendency of the Separation of Convicts, One from the Other, to Produce Disease and Derangement* (Philadelphia: E.C. & J. Biddle, 1849).

<sup>318</sup> Packard, *An Inquiry*, 51-55.

attested to by other institutional doctors, including Samuel B. Woodward, who had experience in both Connecticut's state prison and Massachusetts' state insane asylum.<sup>319</sup>

The question of “derangement” was more complex. Conspicuous among these detriments was the matter of masturbation and mental health, which was so common that Eastern State's officials had developed their own use of the term *dementia* to describe the temporary mental state they associated with self-pleasure.<sup>320</sup> Woodward, however, stopped short of agreeing with speculation that “the natural tendency of the solitary cell to produce masturbation” worsened health conditions in the absolute separation at Eastern State. While he did not doubt that “the mind in perpetual solitude is more likely to become fatuous,” through experience Woodward knew there were “ample opportunities” in any prison to practice what he called a “vice” and Packard called “self-abuse.”<sup>321</sup> Certainly, all prisons were becoming increasingly confining and separating structures in which the imprisoned felt more alone with their thoughts, which could perhaps lead to self-pleasure or depression just as easily as it could to penitence. The varying outcomes of new prisons' physical powers led Charles Evans, eponymous son of the Philadelphia philanthropist, to advocate for staff to have discretion for alleviating separation's “overwhelming force” in cases where “owing to their peculiar mental or physical condition, are unable to bear up against its depressing and debilitating influence.”<sup>322</sup> Evans therefore named the structures effected by his father's peers in the name of “alleviating miseries of public prisons” as a source of miseries in new prisons.

Woodward also noted that extreme solitary confinement seemed to cause rates of dyspepsia (i.e., indigestion) that were unparalleled in other institutional settings, where—though he did not note this—

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<sup>319</sup> Packard, 55-59.

<sup>320</sup> Packard, 60.

<sup>321</sup> Packard, 61.

<sup>322</sup> Charles Evans to the Philadelphia Prison Society (1850), in “Letters on Prison Reform, 1849-1850,” Box 1, Folder 1, William Parker Foulke Papers, HSP.

most occupants' day-to-day included more movement and less anxiety.<sup>323</sup> Indeed, Dr. Darrach had recorded 103 cases of either constipation or dyspepsia during 1841.<sup>324</sup> This meant the physician had confirmed serious and lingering digestive issues in more than one in four Eastern State prisoners, and an even higher rate among those identified as Colored. Packard believed his colleagues who attributed general disparities in Black convicts' health at Eastern State to a climate zone suitability issue of "the African race," rather than to any difference in how they were treated in or affected by solitary confinement.<sup>325</sup> If anything, the experiences of Black convicts at Eastern State was to Packard a hindrance to fairly judging the structure's abilities, given how "depraved...forlorn...[and] of the most hopeless character" he deemed those people in the Black community who had been convicted of crimes.<sup>326</sup>

To devolve into such racial prejudice was also to distract from the quite real physiological and psychological effects of such confinement on most anyone. Yet such biases were omnipresent in how prison professionals considered evidence that periods of seclusion led to cases of insanity.<sup>327</sup> These professionals adopted scientific lenses by which they were generally prone to see each prisoner's body as a chemical and mechanical system that, like the prison structure itself, could prove flawed or experience "vitiating" by bad airs.<sup>328</sup> As they would among machines from manufacturers of varying repute, officials

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<sup>323</sup> Recent studies of nineteenth century diagnoses have concluded that dyspepsia likely meant aches in the stomach area rather than graver conditions like ulcers. See, Jeremy Hugh Baron and Amnon Sonnenberg, "Early History of Dyspepsia and Peptic Ulcer in the United States," *The American Journal of Gastroenterology* 104, no.12 (2009): 2893-2896.

<sup>324</sup> Darrach, "Tabular View of the Medical Cases of Coloured Prisoners..." and "Tabular View of the Medical Cases of White Prisoners..." *Medical Cases of Prisoners*, 1841.

<sup>325</sup> Packard, *An Inquiry*, 60. Packard was perpetuating baseless notions of racial climatic suitability that had arisen as justifications for enslaving Africans to labor on Caribbean and Southeast US plantations. By the 1840s, similar ideas were central themes in discussion of race in America and adopted even by some abolitionists. See Katherine Johnston, *The Nature of Slavery: Environment and Plantation Labor in the Anglo-Atlantic World* (Oxford University Press, 2022); Colin Fisher, "Antebellum Black Climate Science: The Medical Geography and Emancipatory Politics of James McCune Smith and Martin Delany," *Environmental History* 26, no. 3 (2021): 461-483.

<sup>326</sup> Packard, *An Inquiry*, 74-75.

<sup>327</sup> "Insanity in Prisons," 1852, in "Prison Reform Scrapbook."

<sup>328</sup> John Stanton Gould, *A Report on Food and Diet suited for Almshouses, Prisons, and Hospitals* (New York: Wm. C. Bryant & Co., 1852), 8, 11-13, 48-57, MHS.

judged the supposed qualities of prisoners bodies their age, gender, or ethnicity. Many categories and occasionally individual inmates were deemed too delicate for extreme isolation, with the implication that the others were too sturdy for isolation to harm. Others thought the entire convict population by default was resistant or resilient enough that what could appear to be damaging loneliness was instead experienced differently by a prisoner. In 1852, the scientist and philanthropist John Stanton Gould made it known that he saw a categorical distinction between the “feeble pauper” found at an almshouse and “robust” prisoners.<sup>329</sup> With this type of assumption about prisoners’ inherent physical and mental durability, proponents of isolation and Eastern State physicians in particular went on for decades denying that separation had ever caused mental illness.<sup>330</sup>

Contrarily, in 1855, Philadelphia area lawyer, social reformer, and natural historian William Parker Foulke’s interest in cellular separation was connected to his belief that there was no group of people that could be fairly characterized as a criminal class. Among the “very large number of acts” that annually fell to the criminal courts for judgment, he saw “various degrees of moral wrong,...various degrees of temptation,...and by individuals who resemble one another in [only] few circumstances.”<sup>331</sup> Foulke thought any citizen with average reasoning abilities would consider the community in which a convict lived or where the crime occurred, the person’s social network, their sex and age, plus “a thousand other things” and accordingly tailor the appropriate penalty to each convicted person. This perspective shows that various proponents of separation took both sides of an innate explanation for criminality as opposed to an environmental explanation. While the doctors adopted the former in trying to dissuade sympathetic fears about isolation’s damage, Foulke adopted the latter in support of the idea that the prison could truly change people. Either way, the discussion revolved around the powerful prison structure itself.

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<sup>329</sup> Gould, *A Report on Food and Diet suited for Almshouses, Prisons, and Hospitals*, 7.

<sup>330</sup> Letter from Physician George L. Taylor, *Thirty-Seventh Annual Report of the Board of Inspectors of the State Penitentiary for the Eastern District of Pennsylvania* (Philadelphia: McLaughlin Brothers, 1866), 93, ESP.

<sup>331</sup> Foulke, *Remarks on the Penal System of Pennsylvania*, 12.

Foulke lamented that reform of Pennsylvania's penal institutions had not advanced as far as it might have in the more than six decades since the Society for Alleviating the Miseries of Public Prisons had first influenced Walnut Street's construction.<sup>332</sup> Reformers like him, with "patience and courage," continued to press for the various Pennsylvania prisons, especially county jails, to be uniformly built and administered on the principle of prisoner separation.<sup>333</sup> Foulke lauded the original commissioners of Eastern State for their selection of an architect, Haviland, who had adhered to that principle. Haviland had figured out how to fully separate people with stone and cementitious materials and withholding from "prisoners opportunity for improper intercommunication."<sup>334</sup> By technical skill and originality, Foulke believed that Haviland had created at Eastern State the minimum exceptions to separation necessary for the admission of fresh air and the drainage of foul matter as well as for granting access to check in on and provide food or clothes to each prisoner. To Foulke, this was the type of environment that should constitute all imprisonment in Pennsylvania. Otherwise, county jails would continue to allow "promiscuous intercourse, in idleness," would continue to threaten the youth who went unseparated from others, and—for those who went on to serve time at Eastern State—would continue to "neutralize" the penitentiary's potential to dissociate convicts both from one another and from their own criminality.<sup>335</sup>

Foulke was incredulous that some Pennsylvania counties had recently constructed jails without hiring a professional architect.<sup>336</sup> He strongly supported John Haviland's subsequent projects to replicate Eastern State's structural separation at the county level. In his 1855 remarks, he reprinted Haviland's 1851 specifications for "a small county jail containing twelve cells, and apartments necessary for the accommodation of the keeper."<sup>337</sup> In these general specifications, Haviland continued to advance his

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<sup>332</sup> Foulke, *Remarks on the Penal System of Pennsylvania*, 5.

<sup>333</sup> Many of Foulke's personal experiences of visiting and critiquing county jails are documented throughout "Letters on Prison Reform, 1849-1850," Box 1, Folder 1, William Parker Foulke Papers, HSP.

<sup>334</sup> Foulke, *Remarks on the Penal System of Pennsylvania*, 9-10.

<sup>335</sup> Foulke, 13-14.

<sup>336</sup> Foulke, 10.

<sup>337</sup> Foulke, 47.

replacement of brickwork and stone masonry with “concrete, formed with broken stones and mortar well grouted.”<sup>338</sup> In a demonstration of the continuing coevolution of masonry technologies and ideas of sanitation, this concrete material was to constitute three-inch thick privy floors.<sup>339</sup> The walls and ceilings of Haviland’s new model jail remained a “plaster mortar” concoction without hydraulic cement, but his instruction for three coats “composed of good well burnt wood lime, and hair in approve proportions, with clean sharp sand,” reflected both the ever-widening array of cement qualities available in the United States and the increased attention paid to characteristics of sand that might affect cohesion and density. The cost of such materials was also falling, making Haviland’s ideal jail more attainable in the small counties for which it was intended.<sup>340</sup>

After years of debate, a general consensus favoring cellular separation had emerged by the 1850s. In November 1860 at an event hall in Manhattan, Foulke told convention-goers of the American Association for the Improvement of Penal and Reformatory Institutions that he did not see significant differences among American prison systems. Whether in New York or in Pennsylvania, “the parties were all aiming at the separation of prisoners.” Concerns about prisoner health were cast aside by prison officials, who instead focused on exactly how much separation to use, including whether only overnight or round-the-clock. As Foulke articulated in his 1860 speech, this was typically seen as deciding between, on the one hand, the revenue-producing opportunity of congregate labor and, on the other, the potential for full moral reform of each prisoner.<sup>341</sup> There was no question that separation of individual convicts was key in the prison’s potential to slow the spread of criminality, viewed as it was like a contagious and potentially terminal illness. For this reason, in the 1860s structures of individual isolation became seen as especially important for incarceration of those whose “young minds” were perhaps most receptive to and

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<sup>338</sup> Foulke, 48.

<sup>339</sup> Foulke, 50.

<sup>340</sup> Foulke, 52.

<sup>341</sup> William Parker Foulke, *Remarks on Cellular Separation of American Association for the Improvement of Penal and Reformatory Institutions* (Philadelphia: H.B Ashmead, 1860), 14, LCP.

worthy of saving from thinking like what later generations would call hardened criminals.<sup>342</sup> In complete contrast to evidence-based policies today, solitary confinement was intentionally used for juveniles across the Northeast US, and its availability even allayed some officials' and observers' worries about imprisoning youth.<sup>343</sup>

#### Cement: Standard of Prisoner Reform and Modern Hygiene

There was of course more context to prison developments in the 1860s and 1870s than this turn toward using isolation so intentionally as a prophylactic against criminality among youth. New prison structures across the country, including in the Reconstruction South and especially the West, were similarly intended to get ahead of future criminality, but here with an eye toward growing or transforming populations rather than individuals. Also defining this era in prison construction was the rapidly increasing availability of hydraulic cements from natural cement districts and, in some areas, from import of synthetic cements. While in previous decades the cementing materials for a prison were always important but often imprecise in quality, now hydraulic cement was an obvious and reasonable specification. This was the context for Montana's as yet unrealized prison specifications of 1869, but Montana was far from an outlier. From South Carolina to Arizona, prison commissioners named either hydraulic cement in general or from a specific source location, such as Louisville, for the material that they trusted to make a modern penitentiary.<sup>344</sup>

While hydraulic cement and concrete were becoming standard specifications for prisons across the United States, they were also increasingly standard components for various types of other institutional buildings, both penal and penal-adjacent, constructed by governments. This general practice of

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<sup>342</sup> *Thirty-Seventh Annual Report of the Board of Inspectors*, 92.

<sup>343</sup> On solitary confinement as a punishment for juveniles in Rochester, NY, see J.K. Fagan, *Report of Committee on Contracts on the Subject of Their Visit to Penal and Reformatory Institutions* (Boston: Rockwell and Churchill, 1874), 6, MHS.

<sup>344</sup> "Report of Superintendent of Penitentiary," *The Daily Phoenix* (Columbia, SC), May 15, 1868, 1, CA; "The Territorial Prison," *The (Yuma) Arizona Sentinel*, November 10, 1877, 2, CA.

institutional construction was key to the continued consensus-building around reformist prison societies, much of which occurred at conventions like the aforementioned 1860 Manhattan gathering or the National Congress on Penitentiary and Reformatory Discipline, held at Cincinnati in 1870.<sup>345</sup> The latter gathering mixed private citizen advocates and prison professionals who primarily discussed issues of administering a prison, including the sorting out of inmates who were perhaps better institutionalized elsewhere.

Notable among sorting considerations was what had become a vexing problem: prisoners apparently feigning insanity in hopes of transfer to what they thought would be an easier and less isolating existence at an asylum.<sup>346</sup> Suspicion that prisoners were employing this strategy made difficult any reckoning with the true degradation of mental health within modern penitentiaries. Convention speaker Zebulon Brockway, an amateur prison penologist and prison administrator then attempting radical reforms of Detroit's sentencing and parole, was somewhat more orthodox in describing an organizational flow chart with the position titles and institutions he thought should exist within an entire state corrections system. This network of walled-off enclosures was what he thought necessary for properly separating various wards of the state. Indeed, states including Pennsylvania were reorganizing bureaus and departments to oversee proliferating institutions and tie them to systemic government matters such as "Improvement of the Dwellings of the Laboring Classes."<sup>347</sup>

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<sup>345</sup> Other conventions included those of the National Prison Association of the United States, see "The Second Annual Report of the same from The National Prison Reform Congress held at Baltimore, 1873," appended to E.C. Wines, *Report on the International Penitentiary Congress of London, held July 3-13, 1872* (Washington, DC: Government Printing Office, 1873).

<sup>346</sup> Z.R. Brockway, "The Ideal of a True Prison System for a State," A Paper Read before the National Congress on Penitentiary and Reformatory Discipline, at Cincinnati, on October 12, 1870, 11, MHS.

<sup>347</sup> The reorganization is evidenced in the series "Annual Reports of the Board of Public Charities and 'Committee on Lunacy,'" Defunct Offices, Record Group 23, Department of Human Services (previously Department of Public Welfare), PSA. For "Improvement of the Dwellings of the Laboring Classes," see specifically *Second Annual Report of the Board of Commissioners of Public Charities of the State of Pennsylvania* (Harrisburg, PA: B. Singerly, state printer, 1872), xciv.

During the 1870s, Eastern State officials carried out changes in both the physical structure of cells and how staff used those structures. To an extent, these changes simply expanded and made more overt changes that had been occurring slowly since soon after the penitentiary opened. But taken together, the changes were a significant alteration to if not deviation from Pennsylvania-style solitary management. The state constructed three new cellblocks during the decade, the chosen response to ongoing overcrowding that by 1876, just before the building project, entailed 911 inmates assigned to 580 cells.<sup>348</sup> All cells in the new blocks had doors onto the central corridor rather than only a small food for delivering food and sermons as was the case for cellblocks built in the 1820s. The new building phase included a remodeling by which any remaining cells of the old design had their corridor opening enlarged and their exterior entry filled with mortar.<sup>349</sup>

The practice of solitary exercise yards, already phased out and of course unfeasible amid overpopulated prisons, was no longer even possible. This meant that a supposedly humane environmental isolation was no longer experienced by all prisoners. Instead, a slightly more communal but also recognizably harsher environment was the norm, and those who transgressed prison rules were exposed to a more subjective guard-centered system of control. Yet prominent among the means of punishment then available to guards was the harshness of certain architectural features. In 1874, the Pennsylvania Board of Public Charities reported that twenty-two different male prisoners were punished by “dark or punishment cells” a total of twenty-four times during the year.<sup>350</sup> The practice was perhaps not well received by inspectors, legislators, and interested members of the public in Philadelphia. Much less use of dark or punishment cells at Eastern State was reported in 1875. Use reported in 1876 was again less than in 1874,

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<sup>348</sup> *Seventh Annual Report of the Board of Commissioners of Public Charities of the State of Pennsylvania* (Harrisburg, PA: B.F. Meyers, state printer, 1877), 25, PSA.

<sup>349</sup> Edward Townsend, October 20, 1875, “Warden’s Daily Journal,” Warden’s Daily Journals 1850s-70s, ESP.

<sup>350</sup> “Kinds of Punishments,” *Fifth Annual Report of the Board of Commissioners of Public Charities of the State of Pennsylvania* (Harrisburg, PA: B.F. Meyers, state printer, 1875), 108, PSA.

and much less than similar punishment reported at Western State.<sup>351</sup> Eastern's warden would later claim the facility had not used such extreme isolation as punishment for several decades.<sup>352</sup>

Deployment of the most fully sealed cells for punishment was nonetheless a trend and one that corresponded to intensifying dehumanization of prisoners along categorical lines of race and heredity. Such attitudes were pervasive, found even at the National Conference of Unitarian and other Christian Churches, held at Saratoga, New York in 1874. There, the Reverend John Farwell Moors spoke of the "criminal class" and "their hereditary impulses."<sup>353</sup> Moors believed members of that supposed class could be reformed if only compulsory school attendance were enacted, allowing public education to break the connection between "ignorance and crime." He slid easily back and forth between biological and environmental explanations of criminality, which was in keeping with the time's pervasive and flexible applications of social Darwinism.<sup>354</sup> Once again, separation was the forgone conclusion whether the criminals were hopeless "hereditary" cases that society needed to put away indefinitely for its own safety or whether the criminals needed to be robustly but temporarily controlled for re-education. This conclusion explains proliferating cultures of institutionalization in the new asylums, houses of refuge, and prisons, as well as the cultures of "grading" the confined that subsequently emerged.<sup>355</sup>

Rising notions of graded prisoners, with some being perhaps innately incorrigible, underlay a renewed questions of cruelty and hygiene at international conventions on prison construction and management in the 1870s. At the 1872 International Penitentiary Congress of London, the French

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<sup>351</sup> *Seventh Annual Report of the Board of Commissioners of Public Charities of the State of Pennsylvania*, 135, PSA.

<sup>352</sup> Michael J. Cassidy, *On Prisons and Convicts: Remarks from Observation and Experience Gained During Thirty-Seven Years Continuous Service in the Administration of the Eastern State Penitentiary, Pennsylvania* (Philadelphia: Patterson & White, 1897), 31-32.

<sup>353</sup> Rev. John Farwell Moors, "Punishment of Criminals," a paper read to the National Conference of Unitarian and other Christian Churches, at Saratoga, New York, September 17, 1874, MHS.

<sup>354</sup> For the influence and definition of such ideas as well as their flexibility in ideological debates, see Mike Hawkins, *Social Darwinism in European and American Thought, 1860-1945: Nature as Model and Nature as Threat* (Cambridge University Press, 1997).

<sup>355</sup> Board of Commissioners of Prisons, *Special Report of the Commissioners of Prisons of Massachusetts...* (1894), 46-47.

delegation reported that cement floors were now stipulated over flagstone, tile, or plank. This was partly in keeping with France's stated goal of managing prison humidity in order to avoid unhealthy moisture and bad airs. It was also, in combination with standards to plaster or whitewash walls, a measure that allowed for janitorial contractors to perform "frequent and repeated sweepings, washings, and cleanings" and even to on occasion effectively fumigate prison spaces to halt uncleanly growths.<sup>356</sup>

Much more common than sharing of material specifications were updates by the attending nations on their practices of separation. Various states within newly unified Germany reported. In a contradiction of US conclusions, Prussian officials could not find a difference in cellular versus congregate systems in terms of recidivism, but they cryptically called separation's effect on prisoners during incarceration "decidedly favorable," perhaps simply meaning the prisoners were accordingly pacified. Prussia at the time reported little sorting of prisoners into different institutions or cellblocks beyond the young from the older. Württemberg reported using solitary cells almost exclusively for punishment.<sup>357</sup> Russia sorted primarily between men and women and between convicts and those awaiting trial. But even those males convicted of serious offenses or infractions while jailed experienced a truncated version of the Russian prisons with their strong focus on solitary cells. The nation reported using small cells that were open on the top, creating exposure between them beneath a common roof, such that they also shared a system of adequate lighting and ventilation. The delegation reported opposition to "cellular imprisonment for long periods," having concluded this "must either render the prisoner torpid, or produce in him such a constant feeling of restraint as will necessarily paralyze the play and development of his individual will, sole means of his regeneration."<sup>358</sup> The English agreed, calling long period of cellular seclusion "enfeebling" for the prisoner, though like the Swiss they saw it as a necessary first step to most any individual program of reform through incarceration.<sup>359</sup>

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<sup>356</sup> Wines, *Report on the International Penitentiary Congress of London*, 78-79.

<sup>357</sup> Wines, 15-16.

<sup>358</sup> Wines, 21.

<sup>359</sup> "England," Wines, 26; "Switzerland," Wines, 22.

The reports and discussions in London evidenced that American systems of cellular construction remained influential. At the same time, they magnified conflicting opinions that also existed in the United States about the humanity and effectiveness of solitary as well as continued reservations stemming from how separation limited a prison's potential revenue from inmate labor. A third international prison congress, held at Stockholm in 1878, largely stayed the course. Among the unadventurous resolutions that delegates approved was a statement condoning cellular separation regardless of race, social condition, rural or urban origins, or sex, while at the same time cautioning that its use for youth should be "of a sort not detrimental to their physical and mental development."<sup>360</sup> Making more waves out of Stockholm was the Congress' approval of "a more strict imprisonment" as a disciplinary category that could include removal of furniture from the cell, darkening the cell, or "depriving him of the permission to read and work."<sup>361</sup> This formalized structures as a tool of punishment in the guard-centered system of prison management rather than as an objective and even merciful component in the penitence process of reform.

A Fourth International Prison Congress was held in June of 1890 at St. Petersburg, this time with a new facility featured at its center. Russian officials were proud to have their recently completed Viborg Prison as the convention's star.<sup>362</sup> Attendees visited Viborg and poured over the plans of its five-story main building, where four wings of equal length formed a cross that was palatial from the outside and dreadful within. It was in many ways an updated Eastern State that contained 1,200 single-occupancy cells approximately two-meters by three and knit together in a structural ecosystem of lighting, ventilation, and waste removal.

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<sup>360</sup> Rev. Fred H. Wines, *Report on the International Prison Congress Held at Stockholm, Sweden, August 20-26, 1878* (Springfield, IL: Weber, Magie & Co., state printers, 1879), 7.

<sup>361</sup> E.C. Wines, "Report and Discussion on the International Prison Congress of Stockholm at the Social Science Congress of Cheltenham, England," October 26, 1878, 2, MHS.

<sup>362</sup> Board of Commissioners of Prisons, *Special Report of the Commissioners of Prisons of Massachusetts*, 25; Randall, *The Fourth International Prison Congress*, 239.

As large as it was, Russian officials only intended this separation-focused prison for short sentences.<sup>363</sup> This was in keeping with the congress' stated commitment to prison reform as a means to rehabilitation in the style envisioned by the venerated John Howard. The convention-goers heartily celebrated Howard's concept of using structural separation to ameliorate the arbitrary treatment of guards, though the concept seemed in peril on the centennial of its adoption by the State of Pennsylvania by way of Philadelphia's Prison Society. Delegates at the convention openly wondered about whether US officials remain committed to prisoner rehabilitation, identifying the nation, with its fading commitment to beneficial separation and its hodgepodge of state prisons, as an object of reform rather than a leader in that arena.<sup>364</sup> Zebulon Brockway in fact tried to open a discussion on "incurability" or, in other words, how prison staff might better identify those who had no hope of rehabilitation and what should be done with them at that point.<sup>365</sup> The congress made a heavily qualified resolution acknowledging that charges of incurability were occasionally understandable, though the weight of their resolutions still fell overwhelmingly toward a belief that isolation in the penitentiary was a vehicle of progress toward re-entering society.<sup>366</sup>

Back in the United States, cement prison construction marched on with a relative uniformity that belied the claims of state-to-state discord that had been leveled in St. Petersburg. Much construction was a response to continued prison overcrowding, which largely precluded the ideal of leading convicts to penitence via structural separation from social distractions. Montana's Deer Lodge, full from the moment it opened in 1871, nonetheless began a seclusion-focused building phase in the 1890s that created a particularly harsh environment. Two hundred new cells had dense masonry walls that deftly excluded sounds and daylight but not the dangerously cold air on winter nights at 4,500 feet above sea level and 46.4° latitude. The late Montana historian Ellen Baumler found that, to keep prisoners from freezing to

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<sup>363</sup> Randall, 237-247.

<sup>364</sup> Randall, 27-28.

<sup>365</sup> Randall, 124.

<sup>366</sup> Randall, 175-178.

death, guards burned wood fires and many oil lamps.<sup>367</sup> The smoke and fumes mixed with putrid odors from each cell's open waste bucket, no provisions having been made for plumbed toilets. Everyone surely agreed the masonry was too effective at keeping this foul air inside. The resulting unhealthfulness was a consummate failure for the penitentiary.

A few years later, in 1894, the Massachusetts Commissioners of Prisons delivered the Legislature its requested report on plans, specifications, and cost estimates for a prospective new state prison. The officials recommended cement in not only all flooring applications but also for general fire-proofing reasons as well as for lining cell walls.<sup>368</sup> The same year, Eastern State officials began a new round of construction. Of the 278 barrels of cement used, more than thirty-eight tons, some ninety percent went into building new cells.<sup>369</sup> As in the work imagined by Massachusetts officials that year, the hydraulic cement likely went disproportionately into flooring while its use in walls was supplemented considerably by lime and other plaster minerals, though to a similar effect.

Eastern State Penitentiary also provides a case study for one particular realm in which separation was in some ways intensified and in others diminished: restructuring for tuberculosis treatment. At Eastern State, this project continued well into the 1920s, but it began in earnest around 1880. Pulmonary tuberculosis was long a recognized problem in prison environments, and Eastern State Inmate No. 19 had died of the disease the year after the facility opened. By 1880, it was named responsible for at least half the deaths that inmates suffered while incarcerated, with the true fraction perhaps higher.<sup>370</sup> Still, prison officials had long claimed its cellular separation inhibited the disease's spread, and it seemed true that at least in the early years many of the deceased had contracted tuberculosis outside the facility. At the

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<sup>367</sup> Ellen Baumler, *Dark Spaces: Montana's Historic Penitentiary at Deer Lodge* (University of New Mexico Press, 2008), 19.

<sup>368</sup> *Special Report of the Commissioners of Prisons of Massachusetts*, 15-16.

<sup>369</sup> *65th Annual Report of the Board of Inspectors of the State Penitentiary for the Eastern District of Pennsylvania, for the Year 1894* (Philadelphia: Allen, Lane & Scott, 1895), 24-25, ESP.

<sup>370</sup> Erica Harvey, "Eastern State Penitentiary's Cellblock Three: Transforming for Tuberculosis" (MA thesis, State University of New York at Oneonta, 2008), 31.

century's end, this was a reason to continue structural isolation at Eastern State. And yet, the popular "rest cure" treatment for those already ill involved environmental aspects of fresh air, bountiful daylight, and gentle walking that were at odds with the dense walls and round-the-clock seclusion of a penitentiary. Eastern State's staff incorporated these ideas of health in a gradual project to convert one cellblock into a hospital with various structures antithetical to separation, including a communal exercise yard for patients, wide arched exterior doorways for ventilation, and extra windows for sunlight to penetrate.<sup>371</sup>

### Punishment by and Exploration of Ubiquitous Cement

At the start of the twentieth century, prison reformers no longer subscribed to earlier ideas that benevolently separating structures would guide each prisoner to a moral transformation. Even at Eastern State, the practices of separation had subsided. There, extreme separation was now primarily a practice reserved for first-time offenders and young convicts, demographics believed to be especially vulnerable to corruption by fellow inmates.<sup>372</sup> Most cells were not so closed off to the world, and most prisoners did not spend the entire day in a single chamber. The factors in this shift were many, including the financial impracticalities of solitary, the continued tendency of US prisons to exceed their capacities, and the broad realization that so greatly cutting off a person from the rest of the human and nonhuman world was bad for them.

At no point in modern prison development had anyone argued that containment in a near-windowless masonry cell was the most desirable way to live, and there had always been public voices naming the detriments. But now, with cement materials and techniques of concrete were creating an appreciably different degree of austere isolation. Architectural historian Jeffrey A. Cohen has argued that concrete prison construction in this era, from Eastern State to Alcatraz, "radically transformed the

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<sup>371</sup> Harvey, "Eastern State Penitentiary's Cellblock Three: Transforming for Tuberculosis," 32, 39, 58.

<sup>372</sup> Jeffrey A. Cohen, "Renewal, 1900-23," 184, in Marianna M. Thomas and Jeffrey A. Cohen, eds., *Eastern State Penitentiary Historic Structures Report*, Vol. 1 (1994).

penitentiary visually and functionally, and permitted its effective operational lifetime to be extended by half a century.<sup>373</sup> Though it is clear that significant continuities existed throughout the earlier masonry structures and the modern penitentiary, there was something new about fully concrete spaces and their implications for prison cultures. The previous claims that solitary cells were beneficial on account of cleanliness and protection now only held up on the narrow grounds of potentially preventing the spread of fatal diseases like tuberculosis. Rather, the new concrete structures were, in Cohen's words, "cold and mechanistic," and this forced a reckoning.<sup>374</sup> Building new prison cells was now a process of embracing cement as a collaborator in either the most utilitarian treatments of people or in their heartless punishment. This was especially the case in construction of new solitary cells, the intent of which changed markedly at Eastern State during the shift to the concrete age.

By 1909, Eastern State had its original seven cellblocks plus four more, three built in the 1870s and one final brick and stone masonry structure built in 1894. The new blocks completely filled in the radial arrangement by which Haviland had maximized both airflow and individual yard space appended to each cell in the original design (Fig. 2.3). From 1909 to 1926, Eastern State officials added two more large infill cellblocks entirely of concrete: Cellblock 12 and Cellblock 14. Less well documented in its construction timeline, but infamous by its use, was the much smaller Cellblock 13, a handful of single-occupancy spaces tacked onto the outer edge of Cellblock 10. Amid all the new concrete construction, these ten cells stood out because they so openly embraced cement's potential to punish by environment separation. While skylights and other apertures in older cells were being replaced and enlarged to allow more daylight and more ventilation, Cellblock 13 comprised dark and poorly ventilated spaces measuring just four feet by eight.<sup>375</sup>

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<sup>373</sup> Cohen, "Renewal, 1900-23," 185.

<sup>374</sup> Cohen, "Renewal, 1900-23," 184.

<sup>375</sup> For Cellblock 10 details and the general opening up of the cell walls and ceilings, see: Jeffrey A. Cohen, "Fabric Summary," 287, in Marianna M. Thomas and Jeffrey A. Cohen, eds., *Eastern State Penitentiary Historic Structures Report*, Vol. 2 (1994). For Cellblock 13 details, see the same, 310.

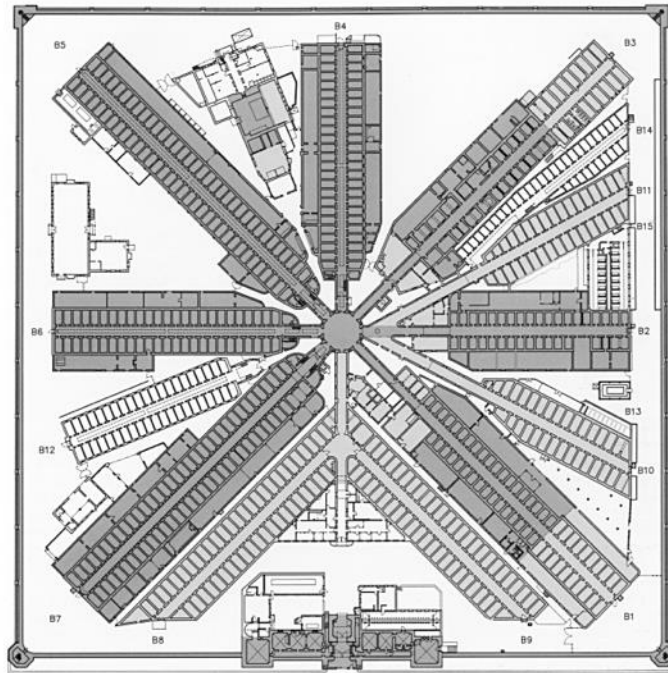


Figure 2.3. Plan view of Eastern State Penitentiary after infill in the early twentieth century. The most heavily shaded elements, including the exterior wall, gatehouse, and seven radiating cellblocks, were original to the first phase of construction that began in the 1820s.

The solitary cells of Block 13 were sometimes called “Klondike,” a name that traveled around the prison as it was applied to several different punishment areas in the twentieth century. Many of these “administrative” or “segregation” groups of cells were retrofits of older cells that involved painting the surfaces black and replacing the window with a ventilating slit that was either closed to create darkness or open, which allowed for rushing cold air that may account for the name Klondike.<sup>376</sup> The new all-concrete spaces were quite variable in temperature. Some, less conspicuous than Cellblock 13 because they were underground, miserably trapped the heat radiating from large hot water pipes that served the buildings above.<sup>377</sup> Four of these were constructed beneath Cellblock 14, opened in 1926. Prison officials used those four supremely stifling concrete masonry cells for what they deemed the most egregious rules

<sup>376</sup> Jeffrey A. Cohen, “Appendix B: Chronological Research Notes, 1920-1994,” 442, in *Eastern State Penitentiary Historic Structures Report*, Vol. 2.

<sup>377</sup> Cohen, “Fabric Summary,” 287, in *Eastern State Penitentiary Historic Structures Report*, Vol. 2.

infractions, punishing prisoners with ten to thirty days of no mattress, no blanket, reduced rations, and no light.<sup>378</sup> Former inmate Jesse DiGuglielmo recalled that when his friend, Jimmy Devlin, experienced this separation from light for thirty days, he emerged “almost blind.”<sup>379</sup>



Figure 2.4. Photograph of a bare, underground concrete punishment cell in the Eastern State Penitentiary space that was known as “Klondike” during the early twentieth century. Collections of the Historical Society of Pennsylvania.

Though Devlin’s loss of vision was perhaps temporary, Dick Fulmer, a social worker who talked to long-time prisoners when he joined Eastern State for its final years, saw lingering evidence that “the effect of prolonged time in isolation can be traumatic.”<sup>380</sup> Fulmer arrived in 1966, thirteen years after a state commission uncovered the newer practices of solitary confinement, which unlike Eastern State’s original separation cells had been concealed from visitors. But before those 1953 revelations led to new

<sup>378</sup> Anonymous Inmate 3, “Stop #25 The Hole (‘Klondike’),” Eastern State Penitentiary Audio Tour, published as transcription at [easternstate.org/audio-tour-transcript](http://easternstate.org/audio-tour-transcript), accessed February 22, 2025.

<sup>379</sup> Jesse DiGuglielmo, “Stop #25 The Hole (‘Klondike’),” Eastern State Penitentiary Audio Tour.

<sup>380</sup> Dick Fulmer, “Stop #25 The Hole (‘Klondike’),” Eastern State Penitentiary Audio Tour.

rules against using harsh environments in power struggles with prisoners, a half-century had passed in which guards more or less surreptitiously used these concrete spaces in retributive ways.<sup>381</sup>

As isolation became more openly embraced for its cruelty rather than its redemptive powers among Eastern State staff, it was more widely identified by that trait among members of the still functional Prison Society. In 1915, the Society published a supplement to their *Journal of Prison Discipline and Philanthropy*. On the one hand, they stuck to the organization's founding belief that incarceration should include labor, urging Pennsylvania's legislature to revisit laws from the late 1890s that limited inmates' work. On the other, they notably departed from the organization's central tenet of structural separation. They resolved that the prison under construction in Centre County was a wonderful facility in its current state, surrounded by thousands of forested acres and with its fenced interior dominated by agricultural fields worked by inmates. Its construction, they contended did not need to be carried out any further. Specifically, the Society came out against realizing the level of separation that was intended for that institution, calling its existing concrete perimeter wall palatable but the planned high-security concrete cellblocks unnecessary when more humane dormitories would suffice.<sup>382</sup>

The Centre County agricultural facility contrasted with the relatively high-security Eastern State prison, both which in turn had important distinctions from asylums and the old idea of almshouses. What they shared was some degree of internal separation and the fact that each had a respective role in separating people from all the other people, places, and things that could be called society. In the 1910s, prison officials and consultants including doctors were particularly confident in identifying insanity among convicts. The terminology used by influential prison psychologists including William T. Root, Jr. was telling. Their labels "feeble-minded," "imbecile," and "criminally insane," intended to justify the

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<sup>381</sup> Details of solitary confinement as punishment are recorded in "1923 Log Book," 60-61, Box 1, Guard Log Books 1900-1910 and 1923-1924, Record Group 15, Department of Corrections, PSA.

<sup>382</sup> The Pennsylvania Prison Society, "Penal Legislation of 1915 in the Commonwealth of Pennsylvania, Employment of Prisoners," issued as a supplement of *The Journal of Prison Discipline and Philanthropy* (October 1915): 17, HSP.

sorting and separation of convicts, were *en vogue* among the era's eugenicist professionals who articulated the latest view on innate criminality. The sorting out that Root and others influenced therefore tracks onto a long history of modern buildings furthering people's idea that society would be better off if more individuals were separated out and apart from one another.<sup>383</sup>

Eastern State records demonstrate cement's increasing ubiquity not only in cells and exterior walls but in all components of institutional architecture at the start of the twentieth century. Ubiquitous cement had ramifications that went beyond specific cultures of cruelty. Many of these had to do with the prison environment as it was managed by officials and staff. Health concerns, especially tuberculosis, continued to drive the use of sterile cement surfaces and thick concrete walls.<sup>384</sup> But so too did electrification. In fact, one set of spaces constructed as a make-do electrical plant to support incandescent lighting in the 1890s subsequently became a hospital with bacteriological laboratories.<sup>385</sup> More broadly, the project of electrification involved construction of concrete-walled tunnels below Eastern State to serve as conduits for extensive wiring.<sup>386</sup>

The new tunnels were also one of the features by which ubiquitous cement created opportunities for prisoners. Of course, concrete floors and cemented walls that extended belowground were a barrier to potential escapees, but by the 1930s prisoners were aware that patiently chipping through the right concrete block could expose a cement-lined pathway such as a sewer main.<sup>387</sup> The concrete tunnels that kept subsurface material from making wires inaccessible became a standard feature in twentieth-century escape plans.<sup>388</sup> In the 1940, one Eastern State inmate employed as a prison mason actually applied

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<sup>383</sup> William T. Root, Jr., "A Psychological and Education Survey of 1916 Prisoners in the Western Penitentiary of Pennsylvania," a report to the Board of Trustees of the Western Penitentiary, 47, 53, 54, HSP.

<sup>384</sup> Cohen, *Eastern State Penitentiary Historic Structures Report, Vol. 1*, 184, 187.

<sup>385</sup> Cohen, *Eastern State Penitentiary Historic Structures Report, Vol. 2*, 292.

<sup>386</sup> Cohen, *Eastern State Penitentiary Historic Structures Report, Vol. 1*, 186.

<sup>387</sup> Cement and concrete obstacles to escape routes were noted in subsequent investigations, reported on by the *Philadelphia Record* from 1930 into the 1950s. See "Escapes 1934-1936," Box 20, Folder 698, Prison Facilities, Pennsylvania (*Philadelphia Record*), HSP.

<sup>388</sup> "1956 Escape," Box 20, Folder 698, Prison Facilities, Pennsylvania (*Philadelphia Record*), HSP.

cement as a casing to preserve a tunnel he was slowly digging, but guard discovered his work before he made the successful escape that several others had by using existing tunnels.<sup>389</sup>

Other opportunities provided by cement did not pertain to escape fantasies but rather to creating small comforts and joys despite an incarcerated existence. One significant discomfort of incarceration at Eastern State arose from how the stone and concrete structures fluctuated in temperature with the seasons. Winter could be miserably cold even indoors, and the unmoderated heat of summer encouraged prisoners to find their own cooling techniques. Seemingly unrelated was the fact that in July 1926, the prison's governing board had ordered that all cells should be uniformly floored with well-cemented concrete. The project involved retrofitting hundreds of chambers in the older cellblocks, but the work was still more or less complete in under one year.<sup>390</sup> No doubt Eastern State officials intended this project for some combination of escape prevention and making the cells more sweepable and washable, as was the aim of coating other surfaces with cement in the twentieth century.<sup>391</sup> However, over the years that followed the cement floors contributed to a new cooling technique. One inmate recalled in detail the summer days when "you'd be in a cell it was almost like you gonna suffocate. And there were guys who would flood their cell. Just get buckets of water and throw it in the cell, on the cell floor, since it was all cement

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<sup>389</sup> "Escape Attempts 1940-41," Box 20, Folder 699, Prison Facilities, Pennsylvania (*Philadelphia Record*), HSP.

<sup>390</sup> Cohen, "Fabric Summary," 287; John Groome, January 6, 1927, "Warden's Daily Journal," PSA, accessed digitally courtesy of Erica Harman, Manager of Archives and Records, Eastern State Penitentiary Historic Site.

<sup>391</sup> For an explanation of using cement to finish atop plaster walls, making it so janitorial staff could then "hose down" the walls without damaging them, see Joseph Roach, "Progress Report" (June 10, 1960), 2, Abandoned Documents, ESP.

anyway.”<sup>392</sup> The material’s relative impermeability made it an unlikely helper for creating a measure of comfort in those particular circumstances.



Figure 2.5. The greenhouse at Eastern State Penitentiary as it appears today. Photograph by the author.

The availability and affordability of this relatively impermeable and long-lasting material led Eastern State officials to use it for the floors and worktables of a greenhouse (Fig. 2.4). This building, constructed perhaps shortly before 1934, followed multiple prison hothouses on the property for growing profitable plants. None of those had lasted beyond a couple decades and only a few prisoners were ever allowed to work in them, but the new concrete-filled structure stands to this day and was a greater part of more prisoners’ experiences.<sup>393</sup> In Eastern State’s post-1913 era of sanctioned extracellular recreation and labor, select inmates carried out horticultural activities in the greenhouse.<sup>394</sup> For these men, cement’s

<sup>392</sup> Anonymous Inmate 1, “Stop #9 20th Century,” Eastern State Penitentiary Audio Tour.

<sup>393</sup> Jeffrey A. Cohen, “Fabric Summary,” *Eastern State Penitentiary Historic Structures Report*, Vol. 2, 318. For “only a few prisoners,” see Jeffrey A. Cohen, “Appendix C: Research Notes on Fabric, by Location,” 567 in the same.

<sup>394</sup> Congregate sanctioning in 1913 referenced in Jeffrey A. Cohen, “Redefinition, 1923-70,” *Eastern State Penitentiary Historic Structures Report*, Vol. 1, 240.

regulation of water and warmth was aiding them in experiencing vitality, even as elsewhere on the grounds cement's same properties were testing the vitality of their peers.

In the twentieth century, prisoners also developed cultures with a proliferating technologies of modulating intangible things that *could* permeate cement: radio waves. At Eastern State by the 1920s many if not all inmates were allowed to bring in or acquire personal furnishings and artwork for their cells. Though these offered some warmth and reminders of a world beyond the prison, nothing else actively connected them to that world like a radio receiver. Famously, a *Philadelphia Public Ledger* who visited Al Capone's cell in 1929 heard "strains of a waltz were being emitted by a powerful cabinet radio receiver of handsome design and fine finish."<sup>395</sup> Capone reportedly bought the ornate radio from another convict, which suggests his use of one was not a singular exception.<sup>396</sup> In subsequent decades, Eastern State developed more regulation of radios while also making them more common. One inmate recalled that a four-channel radio became a fixture in the cells alongside the bed, table, commode, and spigot. A set of earphones that plugged into the appliance were standard issue.<sup>397</sup> As Eastern States and other prisons around the world tried to regulate radio access, some inmates began secretly collecting transistors and capacitors and coiled wires to make not only receivers but transmitters by which they could communicate with one another through prison walls.<sup>398</sup>

### Conclusion

The standardization of prison materials toward more uniform, almost textureless settings of incarceration was a necessary premise for the 1971 Stanford Prison Experiment. Psychologists watched with amazement as research subjects, randomly assigned to be either inmates or guards, all became

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<sup>395</sup> "Stop #39 Al Capone's Cell (Restoration)," Eastern State Penitentiary Audio Tour.

<sup>396</sup> "Stop #59 Al Capone's Cell (Update!)," Eastern State Penitentiary Audio Tour.

<sup>397</sup> Anonymous Inmate 3, "Stop #9 20th Century," Eastern State Penitentiary Audio Tour.

<sup>398</sup> Eileen Shumate, Heidi Ratanavanich, and Michael Mccanne, "Stop #67 An Electric Kite," Eastern State Penitentiary Audio Tour.

alternately depressed and resigning or aggressive and inimical. These two forms of change in psyche and behavior, both of which emerged in each category of subject, were attributable to the prison environment itself. They appeared so quickly that a new researcher brought in on day five convinced the project's leader, Dr. Philip Zimbardo, to halt the two-week experiment the following day on account of harm to the subjects. Zimbardo later summarized the experiment, saying "The situation won; humanity lost."<sup>399</sup> The Stanford Prison Experiment, frequently critiqued not only ethically but methodologically, has nonetheless proven sound as evidence for what political scientist Amy E. Lerman calls the "modern prison paradox." This is the enduring suspicion that carceral facilities, spaces designed to either cure or deter criminal behavior, in fact increase the likelihood that the incarcerated will act criminally. The assumptions underlying this suspicion have changed over time. Early nineteenth century prison reformers worried that convicts' overexposure—to raw natural elements of weather and disease, to the judgmental gaze of people outside, and to their fellow convicts as potential associates—furthered criminal behavior. In contrast, early twenty-first century prison reformers know that convicts' isolation increases violence, in prisoners and guard alike, by disconnecting people from healthy sensory stimulation as well as from the experiences of human compassion that undergird belief in and hope for a just world. Highlighting that material-psychological history of prisons is an important way to reckon with the implications of the mass incarceration phenomenon as a major theme of twentieth-century US history.<sup>400</sup>

In 1952, the City of Philadelphia's newly reorganized Department of Public Welfare published a booklet titled *Towards Human Dignity* that informed subsequent policy guidelines called the *Design for Human Dignity*.<sup>401</sup> The booklet contained the department's visions for public assistance to three categories of Philadelphians: the aged, the children, and the lawbreakers. Officials nodded to past injustices of

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<sup>399</sup> Amy E. Lerman, *The Modern Prison Paradox, Politics, Punishment, and Social Community* (Cambridge University Press, 2013), 3.

<sup>400</sup> Heather Ann Thompson, "Why Mass Incarceration Matters: Rethinking Crisis, Decline, and Transformation in Postwar American History," *The Journal of American History* 97, no. 3 (December 2010): 703-734.

<sup>401</sup> "Towards Human Dignity, 1952-1955," A-4762, Reports and Publications, Record Group 84, PCA.

relying too much on sequestration and institutionalization, by which “workhouses for the poor and dungeons for the criminals” had been the tools of addressing these populations. The City would now attempt to view each individual with “recognition of his needs as a living, growing personality.” When it came to corrections, Public Welfare’s new leaders contrasted “a penal philosophy first formulated in the 1790s” that emphasized almost exclusively “punishment through confinement” with their new program of rehabilitation for “salvaging of the individual.” They indeed stated goals that were new and necessary—better training personnel who could add a “human touch” to corrections, delivering social services that truly began with interests and needs of each inmate, and practicing “equal racial treatment” toward lawbreakers. However, the notion that rehabilitation was both novel and at odds with confinement was contradicted by their own city’s rich history of incarceration.

The penal philosophy of the 1790s to which Philadelphia officials referred was intent on punishment through confinement in a historically specific way, with rehabilitation its goal and in relationship with developing technologies of cemented barriers. Ample supplies of lime in Pennsylvania preceded the Prison Society’s ideas for a separate system of penitentiary reform, and cartloads of the material were critical to realizing those ideas to the extent that they were at Eastern State. Those who believed in benefits of the separate system often spoke in terms of a cell structure’s ability to manipulate a person’s thoughts toward reflection and penitence. These proponents of solitary extrapolated from a known world of engineering and technological innovation into an unknown, to them, world of what actually happened in prisons and another unknown, to most anyone, world of what actually happened in the mind of each prisoner. Immediately, concerned onlookers wondered if the extreme isolation of small chambers almost entirely enveloped with dense masonry was in fact counterproductive to humane reformatory goals. That realization led to some easing of solitary practices and the employment of slightly more sympathetic buildings including asylums. Yet it also led many prison officials to embrace extreme isolation as the ultimate instrument of prison punishment.

Once production of cement proliferated across the country, austere and dense concrete dividers and sterile, waterproof surfaces became standard in prisons. In the twentieth century, cement was an active participant in developing carceral cultures big and small. Few of those who, like the Philadelphia officials, reimagined incarceration with greater humanity, more education, and a renewed emphasis on rehabilitation also explicitly stated that this might require reimagining incarceration with less cement, or at least less bare and oppressively dull concrete construction. For decades now, alternatives to bare concrete cells have been central to attempts at more humane correctional institutions the world over.<sup>402</sup> More recently, concrete's isolation of people within oppressive dullness, the difficulties it presents to thermal comfort or even safety—especially relief from overheating in summer, and others sensory consequences, including the cacophonous acoustics of bare concrete but also stagnant odors and lack of views outside, have all been proven to increase psychological discomfort and physical aggression.<sup>403</sup> Yet, other than banning solitary for juveniles, federal corrections officials certainly did not reimagine incarceration with less cement as it assumed greater influence on prison cultures via increasingly strict sentencing guidelines and its own major construction projects. Concrete would remain the default material of prison structures, not only because this was now a relatively cheap and standard material of sturdy institutional construction but because its physical properties of austere separation were assumed inextricable from goals of punishing prisoners and forcing their contrition.

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<sup>402</sup> A notable example in the United States is Chicago's Metropolitan Correctional Center, in which architect Harry Weese very intentionally addressed the harshness of concrete, small-windowed cells even while being beholden to those standards in designing a federal prison. See, Adam Maraganore, "Designing for an Unoppressive Prison Architecture" (MA thesis, University of Cincinnati, 2017), 60-65.

<sup>403</sup> Leslie Fairweather, "Psychological Effects of the Prison Environment," in Leslie Fairweather and Seán McConville, eds., *Prison Architecture*, 1st ed. (Routledge, 2000), 31-48.

CEMENT SURFACES IN THE CITY: THE INFLUENCE OF  
CONCRETE SIDEWALKS ON CIVICS, CULTURE, AND FASHION  
IN URBANIZING AMERICA

On May 4, 1898, Thomas King, a top-hatted delegate to Maine’s convention of the Masonic order, was being a portrait of American gentility. He was also walking along a sidewalk on Exchange Street in downtown Portland. And then rather suddenly, he was doing neither of those things. Instead, King was thrashing about in muddy water many feet underground. A patch of sidewalk—in this case, bricks atop granite slabs atop timber beams— had completely given way, dropping along with King into an abandoned reservoir once used for firefighting. Across the street, three men on a sanitation crew saw the man disappear into the earth below, and they rushed over to the newly formed pit. The crew looked down on a struggling King and, with a patrolman holding curious bystanders away from the pit’s edge, lowered a rope and hauled the distressed man out. According to the next day’s news account, King “seemed a little dazed at what had befallen him.” But he was not seriously injured, only seriously dirty. “His clothes were covered with mud, and he was of course completely drenched,” reported the *Portland Daily Press*.<sup>404</sup>

Thomas King’s heart-stopping experience got right to the center of a what a sidewalk or any solidly paved path is supposed to be. That purpose is not always so obvious today as it was at the time, even outside such a mishap. Paved walks are now taken for granted in city streetscapes and even throughout many suburban neighborhoods as well as business parks, college campuses, shopping centers, and public greenspaces. In some locations it seems the sidewalk’s point is simply to preserve grass. Walk here, everyone. Please do not walk there, because that is where we maintain a lawn. In residential locations, a sidewalk’s point might concern practical services by, for example, establishing a route for mail carriers who deliver on foot. Allowing that various extra reasons for paved sidewalks always exist,

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<sup>404</sup> “Fell into the Pit,” *Portland (ME) Daily Press*, May 5, 1898, 8, CA.

nearly everything called a sidewalk has been engineered to create separation between a person's body and the rougher or dirtier elements of earth below. In the instance of Mr. King, the sidewalk failed remarkably because that separation had disintegrated.

King's fall occurred at a moment in sidewalk history that was notable for two reasons. First, in the years that spanned the turn of the twentieth century, cement quickly became the default material of sidewalk construction in cities throughout the United States. Only a few years earlier, much more variety existed in new sidewalk material. In Portland, new walks of the early 1890s were predominately brick save for select patches of flagstone abutting downtown institutions or high-end homes and a few lengths of boardwalk on the city's islands. Such materials had been typical for American sidewalk construction during an era, in the 1870s and 1880s, when cement was increasingly underfoot throughout cities but was buried in the form of new sewer systems and therefore out of sight. In the 1890s, civil engineers, often with needed support from city council members and abutting property owners, extended their use of reliable hydraulic cement out of sewer pipes and catch basins and up onto the street level.

Second, the context of this moment in sidewalk construction was shaped in several ways by the strength and continuing proliferation of street railways. Streetcars—which, pulled by horses, had shuttled people around US cities for decades—were becoming electrified. These new contraptions attained speeds that spurred municipal action in the name of pedestrian safety. Their rapid travel supported a more suburban development pattern in which many now lived on new streets that, unlike those in city centers, were simply graded dirt. Continuing horse and carriage traffic meant that even paved roadbeds were often dirty. On such blocks, rather than a sideshow in the construction of modern streetscapes, sidewalks were often the first part of a public right-of-way to be improved: graded and graveled where the road was rutted dirt, smooth bricks where the road was jolting cobbles. A “sidewalk” then was not subordinate to some preconceived idea of dividing up the street space as part of a totalized pavement regime. Sidewalks were next to the trolley rails at the vanguard of street improvements. Besides, they were simply necessary for a

pleasant walking experience along streets had become too crowded and too filled with the amalgamated slop of horses and inconsistent road surfaces.

As cement surfaced in the city, it became the standard material of these proliferating sidewalks even in Portland, a place known then and now for its history of brick walks. The many private property owners and civil engineers who preferred concrete walks certainly did so because the material provided an unmatched degree and duration for barriers that reliably separated precipitation from earth and earth from shoes. Cement created a dense horizontal plane between what was below and the intended walking space above. But this separation did more than fulfill the pre-existing wishes of urban pedestrians. As scholars of technology past and present Mikael Hård and Andrew Jamison have noted, “to be effective, urban infrastructures require that citizens adjust their behavior and patterns of life to the demands of the system.”<sup>405</sup> Immediately, concrete sidewalks influenced new behaviors among city officials, property owners, and those navigating the urban streetscape. As the miles of any paved sidewalk added up in American cities with uniform concrete setting the standard, expectations for walking surfaces consistently rose while experiences of walking changed unevenly according to where concrete walks were laid and how they were maintained.

Concrete walks effectively turned outdoor surfaces into an extension of indoor spaces in a way that only rare lengths of flagstone around grand estates or downtown institutions had done previously. But, as self-sustaining as they were compared to less robust sidewalk materials, concrete paths still required help to achieve their highest potential as clean, smooth surfaces. Whose responsibility this was could prove vexing. Built in the public right-of-way, they were ostensibly a city’s to construct, regulate, maintain, and repair as needed. In practice, governing this sprawl of new walks needed property owners’ assistance. In part because private citizens were not always on board, sidewalk connectivity typically paled by comparison to the roads and the overlain streetcar networks. Nonetheless, most cities kept trying

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<sup>405</sup> Mikael Hård and Andrew Jamison, *Hubris and Hybrids: A Cultural History of Technology and Science* (New York: Routledge, 2005), 223.

to enlist abutting property owners in matters such as snow removal, in exchange allowing the abutters some say over sidewalk construction. Other matters of regulation would prove equally complicated, since new sidewalks, and especially the concrete variety, attracted cyclists, street vendors, and loiterers who in various ways threatened the ideal of comfortable and expeditious pedestrian mobility.

Perhaps the least foreseen consequences of new cement sidewalks involved their relationship with rubber footwear that in recent decades had come to inform notions about how walking outside ought to work. Avoiding soaked stockings and muddy boots was always a goal, for personal reasons of comfort and health if not also for social reasons of appearance. Before widespread, primarily concrete sidewalks, the onus in that arena fell more on the individual, who was responsible for wearing sturdy, virtually waterproof boots composed of thick leather or vulcanized rubber. One needed such footwear to move around cities where, like Portland, Maine, snow, slush, or mud covered the ground for significant periods of the year. Ubiquitous sidewalks, however, encouraged city residents anywhere to use more delicate and fashionable shoes as outdoor footwear, at least when that day's weather complied. Indeed, heavier and boot-like shoes, previously almost omnipresent, were increasingly looked down upon as workers' wear, while less practical shoes, by their very flimsiness, broadcast the wearer's elite status.

New footwear fashions—which came to include light colors, canvas uppers, and rubber soles—strongly reinforced desires for clean and clear walking surfaces. After the proliferation of cement sidewalks between 1890 and 1910, none of these footwear styles would necessarily compromise someone's ability to quickly move from home to vehicle to office or shopping place within an American city. Places where poor drainage or uneven ground persisted were places to avoid setting foot if possible. In this context, a growing percentage of urban residents who had the luxury of choosing whether to navigate cities by streetcar, automobile, bicycle, or foot, and frequently by some combination thereof, tended toward mobility options that minimized their need for robust footwear. Less and less did they count on rubber and layered leather to protect their feet. Instead, protecting their stylish and sometimes delicate shoes was a matter of extensive built environments that generously supplemented common

behaviors. Among those behaviors were several civic practices that managed sidewalk space toward an ideal of safe, continuous, and unobstructed pedestrian movement.

In some ways, this history chronicles a case of concrete as the democratizing force in the Progressive Era that other historians have noted it was in other applications.<sup>406</sup> Cement did manage city surfaces in a way that allowed the carriage-less individual to move about with less worry of dirt and damp. However, considering concrete sidewalks as the patchy and inconsistently managed yet highly effective environmental participants they were, reveals something quite different. Though cement did eventually make cleaner walking experiences more broadly accessible, initially the walks helped create new definitions of class and respectability. Neither the owner of pearly white tennis shoes, who shook up her Manhattan athletic club routine by wearing the pair on a train to the Adirondacks, nor the property owner who shoveled his hundred feet of corner lot walk did so for democracy. They were aiming to be fashionable, comfortable, and polite in ways that ubiquitous cement sidewalks supported and encouraged.

This chapter is a history of municipal infrastructure as a history of people's everyday encounters with the substances of sidewalks, which increasingly meant concrete. City infrastructure histories have typically been told as histories of professionalization and planning, two frameworks that remain helpful for understanding sidewalks.<sup>407</sup> Novel titles such as Streets Commissioner and growing respect for recommendations by civil engineers were key to the standardization and proliferation of cement sidewalks at the turn of the twentieth century. However, the framework of materiality allows for a deeper account that incorporates and builds on a beneficial trend of revising how we tell histories of cities. Analyses of class, somewhat novel when Sam Bass Warner, Jr., published *Streetcar Suburbs* in 1962, have since become a foundation for studies of urban systems.<sup>408</sup> Subsequent cultural analyses have revealed

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<sup>406</sup> Gabriel F. Lee, "Concrete Dreams: The Second Nature of American Progressivism" (PhD diss., Stanford University, 2019), 20, 275, 506.

<sup>407</sup> Shane Ewen, *What is Urban History?* (Polity Press, 2016), especially "Transnational Urban History," 114-128.

<sup>408</sup> Sam Bass Warner, Jr., *Streetcar Suburbs: The Process of Growth in Boston, 1870-1900*, 2<sup>nd</sup> ed. (Harvard University Press, 1978).

how categories of gender and race as well as environmental relationships with water or bacteria or horses have all been involved in city development.<sup>409</sup> A focus on cement, myopic as it may sound, is in fact a way to consider this entire array of social and environmental lenses while keeping them grounded—literally, in the case of sidewalks.

### Walking without Cement: Flagstone Districts and Reliance on Rubber

Several significant developments in municipal improvement, urban expectations, and industrial footwear production preceded the concrete sidewalk era. Public interest in the walking surfaces of US cities already had a long history, though for many decades that topic was constrained to a few small districts. Property owners in Boston, for example, engaged local government regarding paved walking surfaces in colonial times. In 1746, a collection of property holders on Boston’s Milk Street petitioned city officials to address pavement, then likely meaning cobblestones filled in with sand, which they claimed were “very much broken & out of repair.”<sup>410</sup> More than a quick resetting of a few cobblestones here and there, the signatories wanted a new, more walking-friendly paving system. Showing consciousness of interconnected environmental and infrastructure systems echoed by scores of subsequent pavement petitioners, these Bostonians also requested the city repair the street’s common sewer to “carry off the water which in great rains or Sudden Showers renders the way unpassable.”

Even as some urban property owners petitioned for heightened regulation of the walking surface environment, their visions did not negate a responsibility of each person to protect their own feet. In cold

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<sup>409</sup> Deborah Simonton, ed., *The Routledge History Handbook of Gender and the Urban Experience* (Routledge, 2017); Catherine McNeur, *Taming Manhattan: Environmental Battles in the Antebellum City* (Harvard University Press, 2014); Andrew A. Robichaud, *Animal City: The Domestication of America* (Harvard University Press, 2019).

<sup>410</sup> “To the Freeholders and other Inhabitants of the town of Boston...the Petition of the Subscribers Inhabitants of said town” [Petition to Repair Milk Street], March 31, 1746, Miscellaneous Manuscripts, MHS. On the likelihood that Milk Street petitioners were speaking of a cobblestone pavement, see Hillary Rayport Hedges, Charles Sullivan, and Brian Pfeiffer, “Historic Paving and Sidewalks in New England,” *Archipedia New England* (June 2019), <https://www.archipedianewengland.org/1600-1699/historic-paving-and-sidewalks-in-new-england/>, accessed February 23, 2025.

climates of the Anglo world, the general expectation had for centuries been that people would enlist hides from goats and cows to keep their feet warm and dry. The sturdier the leather, the more trusted was the shoe to repel unhealthy elements. In his 1716 epic poem alternately titled “The Art of Walking the Streets of London,” the writer John Gay advised: “Let firm well-hammer’d soles protect thy feet, Tho’ freezing snows, and rains, and soaking sleet.”<sup>411</sup> Into the nineteenth century, the difference in qualities among shoes remained a matter of three things: the leather used to make the pair, how they were crafted, and with what, if any, oily or resinous substances the leather was subsequently treated.

While a well-oiled leather shoe could be resistant to water, by the 1810s some American shoemakers were incorporating an explicitly waterproofing material derived from plants rather than animals. Several tropical trees and vines, now called spurges, were long known to indigenous people of the Amazon basin as significant producers of latex.<sup>412</sup> Latex is a milky emulsion of polymers and water that many inhabitants of the Brazilian interior collected by cutting the bark of spurges and draining it into small containers before processing it with a combination of shaping and drying, which allowed the polymers to congeal. Through violent European colonial and industrial networks, merchants began importing this material to the United States, where it was known as Indian or India rubber. In 1812, a shoemaker in what was then Martinsburgh, Virginia, touted this rubber alongside the “fine leather” he used in making foot coverings.<sup>413</sup> Initially struggling to combine rubber and leather parts, if they even attempted it at all, most American footwear makers stuck with all leather for everyday shoes and made all-rubber products to be worn on especially wet occasions. The all-rubber items were either thick enough to be worn alone or were a thin sheathing to be stretched around the leather and worn as a so-called overshoe.

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<sup>411</sup> John Gay, *Trivia: Or, the Art of Walking the Streets of London* (London: Bernard Lintott, 1714), 3, viewed at MHS.

<sup>412</sup> John Tully, *The Devil’s Milk: A Social History of Rubber* (New York: Monthly Review Press, 2011), 20-21.

<sup>413</sup> “Fine Leather,” *Martinsburgh (VA) Gazette*, August 21, 1812, 4, CA. See also, “Boot and Shoe Making,” *Alexandria (DC) Gazette & Daily Advertiser* September 18, 1818, 3, CA.

In the 1820s, rubber imports to the eastern United States grew substantially. The material remained associated most with footwear. In 1825, readers of *The New Hampshire Gazette* in the city of Portsmouth would likely have recognized a campaign of consumer education undertaken by area shoemakers.<sup>414</sup> That January, the paper's writers noted that India rubber shoes had to that point been "scarcely heard of, much less used by our ladies," before implicitly questioning why that should remain true given the comfort and utility of their "elasticity and impenetrability." Those properties, the writer went on, put to shame "the thin and absorbing quality of the leather or stuffs of which shoes are commonly manufactured." A few columns over, shoemaker Samuel Hawks was hawking "a few pairs" of "India rubber over shoes" that he called "impervious to water or damp" and "warranted to keep the feet dry and comfortable." Rubber was assuming a role on the front line of defending Americans' feet against the incursion of moisture.

The Portsmouth 1825 rubber education campaign originated in Philadelphia's non-partisan register of science and philosophy, the *National Gazette*, and it went well beyond either city. Other papers went further in admonishing women to wear rubber in wet conditions. One claimed that "females are becoming to exhibit a little more prudence in their winter apparel." This gave the writer hope that women would substitute "these gum elastic shoes...for the fashionable sandals which are now in use."<sup>415</sup> A version printed in Alexandria cited the opinion of medical professionals "that to keep the feet dry is the most important and effectual precaution for the preservation of the health, particularly in our cold and variable climate." Again, the piece chastised "the female part of the community" for recklessness "by wearing thin shoes." It contended that an affordable pair of rubber overshoes could last for three winters, while implying the cost was no issue when the return was a healthy dryness of one's feet.<sup>416</sup>

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<sup>414</sup> "India Rubber Over Shoes," *The (Portsmouth) New Hampshire Gazette*, January 25, 1825, 3, CA.

<sup>415</sup> "Indian Rubber Shoes," *Martinsburgh (VA) Gazette*, February 10, 1825, 3, CA.

<sup>416</sup> "India Rubber Over Shoes," *Phenix Gazette (Alexandria, DC)*, December 10, 1825, 3, CA.

Standing between rubber overshoes and widespread public adoption was the fact that these products, over time or when too warm, deteriorated back into a sticky mass. Famously, in the 1830s, several industrial experimenters sought a process to stabilize rubber. From this flurry of experimentation, in June of 1844 the United States Patent Office declared industrial chemist Charles Goodyear the rightful owner of intellectual property for a process of what he termed “an improvement in India-rubber” by sulfur infusion and controlled heating, subsequently known as vulcanization.<sup>417</sup> Though Goodyear had come upon this process in association with New England manufacturers of overshoes, his intent with the patent was to encourage broader uses of rubberized textiles. By October, he had released a letter to potential investors and buyers that suggested dozens of uses for the material, including “the cheapest and best Mail Bag, and Ships’ Letter Bag” for use in day-to-day operations of the U.S. Post Office.<sup>418</sup>

In any of these applications, rubber’s ability to exclude the wet and the cold was crucial. In 1858, the Union India Rubber Company were “exclusive manufacturers under Goodyear's patent of all kinds of clothing.” Union produced articles including wading pants for lumbermen and California miners, pea coats for surveyors and exploring parties, and heavy aprons for use by tanners, masons, ice carriers, and stone cutters. Other rubberized clothing protected butchers from stray blood, firemen from stray water, and submarine divers from hypothermia-inducing saturation.<sup>419</sup> Union’s advertisements sometimes explicitly placed rubber within a more detailed environmental system, such as for their ponchos that were intended to spare horseback riders from rain “while allowing a free circulation of air” from below.<sup>420</sup>

The range of advertised applications notwithstanding, vulcanized rubber’s popularity through the middle of the century came first from what the stuff did for the experience of walking in this era before ubiquitous concrete sidewalks. The primacy of footwear among rubber uses was confirmed in 1858, when

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<sup>417</sup> Charles Goodyear, “Improvement in India-Rubber Fabrics,” US Patent 3,633, issued June 15, 1844.

<sup>418</sup> Charles Goodyear, “The subscriber has invented, or discovered, a metallic gum elastic composition,” copy of a letter printed in New York, 1844, MHS.

<sup>419</sup> *The Union India Rubber Co.* (New York: John W. Oliver, 1858), 6-13, Trade Catalogs, HBS.

<sup>420</sup> *The Union India Rubber Co.*, 7.

twenty-three shoe manufacturers remonstrated against Goodyear's attempt to renew his patent.<sup>421</sup> In part because the original patent had been so conspicuously ignored by footwear manufacturers, the judge granted Goodyear a renewal of seven years, only two of which Goodyear lived through.<sup>422</sup> In the decades preceding the explosion of concrete sidewalks, then, stabilized rubber took over from skillfully-joined leather as the material entrusted with keeping Americans' feet dry. Keeping feet dry meant preserving health, while also avoiding the delays or extra work caused by walking with sodden feet or changing and drying wet socks and boots. It was perhaps a corporate responsibility to make rubber footwear available, but thereafter the responsibility for dry feet was an individual matter.

The extent of paved walking surfaces remained rather small. In larger cities, certainly including Boston, municipal officials built and maintained flagstone sidewalks and crosswalks throughout the urban core. Once in place, flagstones, while perhaps not obviating the need for rubbers, were a key part of pavement systems that made walking around a commercial center a much drier and smoother experience than on cobbles, planks, or dirt. However, flagstone walks raised expectations while also generating questions around how walking surfaces should ideally function and who was responsible for maintaining them.

In November of 1859, John Kirby brought a tort action against the Boylston Market Association that revealed both the dangers of impermeable pedestrian pavement and the odd distinction between liability and responsibility on public sidewalks. Kirby had slipped and fallen while traveling a flagstone walk alongside the market building, where the owners had unlawfully allowed snow and ice to

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<sup>421</sup> *In the Matter of the Application of Charles Goodyear for an Extension of the Letters Patent Issued to Him June 15th, 1844, as Re-Issued to Him December 25th, 1849, for an Improvement in India Rubber Fabrics: Argument of James T. Brady, before the Commissioner, in Favor of Such Extension* (New York: W.H. Arthur & Co., 1858), MHS.

<sup>422</sup> Arlesa J. Shephard, "L. Candee & Co. and the U.S. Rubber Shoe Industry," *Clothing and Textiles Research Journal* 38, no. 4 (2020), 255-269.

accumulate.<sup>423</sup> As the case's resolution made clear, however, the owners' illegal failure to remove snow and ice could incur a fine from the City of Boston, but it could not make the city liable for a pedestrian's related injuries. In a harbinger of concrete sidewalk issues to come, the solid flagstone walks not only ought to have been cleared of snow and ice as a courtesy but also needed to be cleared in order to avoid the increasingly hazardous refreezing of water that was effectively dammed from percolating into the ground. The very impermeability of solid stone slabs—which flagstones were at the time and concrete lengths would be subsequently—also meant an increased danger of water pooling and freezing. In the Boylston Market case, the provisions for maintenance (a private responsibility) of safe sidewalks (a public liability) already showed significant shortcomings that would remain in later decades as concrete walks proliferated.

In this pre-concrete era, Boston's elected officials were perhaps more effective in securing sidewalk space in other ways. In 1863, the bicameral council passed an ordinance setting out "Rules and Regulations in Relation to Coal-Holes, Vaults, &c. under the Sidewalks." The new code stipulated that spaces excavated below sidewalks should have walls of granite at least 30 inches thick and "laid with good cement." Pedestrians were to be protected from cave-ins by a ceiling with some combination of iron, arched brick, granite, and "a six-inch thick slab of either Blue or North River flagstone." If any such covering did fail, the pedestrian was to fall no more than eleven feet, the ordered maximum depth. Among the other regulations, the space was not to be used for anything that might by its nature overwhelm the ceiling/sidewalk barrier. "No boiler, steam-shaft, furnace, or steampipe" was to be under a sidewalk, "nor shall any explosive substance or inflammable oil be stored under the same." Owners were responsible for keeping the spaces "safe for public travel" by securely covering them at night or when not in active use.<sup>424</sup>

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<sup>423</sup> "John Kirby vs. Boylston Market Association," 14 Gray 249, 80 Mass. 249; November 1859, 249-253, *Massachusetts Cases: Published Opinions from Massachusetts Courts*, <http://masscases.com>, accessed February 23, 2025.

<sup>424</sup> City of Boston, City Document No. 82: "Rules and Regulations in Relation to Coal-Holes, Vaults, &c. under the Sidewalks," 1863, 3-5, MHS.

Even the quickly industrializing Northeast was like the rest of the United States through the middle of the century, in that the majority of its population still lived in places where the building of coal-holes relative to sidewalks was not a concern.<sup>425</sup> These villages and small towns did not have curbs, gutters, or even a graded roadbed in many cases, let alone a paved sidewalk. In New England, many of these modest settlements still played some role in the region's growing footwear industry. Distributed among them were the cottage shops in which shoemakers made two or three pairs each day, steadily if imperceptibly adding to the region's massive annual output.<sup>426</sup> Footwear firms had begun to organize their work, first systematically and then through consolidated factories, and thereby facilitated a transition from artisans making each pair for a known customer to the impersonal and anticipatory mass production of boots and shoes.<sup>427</sup>

By the 1840s, some Boston shoemakers already kept a stock of ready-made footwear in a variety of common sizes rather than simply filling custom orders.<sup>428</sup> Producing footwear that nobody had asked for was an inherent gamble, in which a maker accepted the deferred responsibility to sell the pair. Indeed, the necessity to sell premade shoes started to foster a profession dedicated to the task. Meanwhile, on the other side of the Atlantic, Ireland's Great Famine was already pushing people to flee that island, and thousands began to arrive in the Boston area in 1846.<sup>429</sup> That concentrated population of immigrants in

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<sup>425</sup> "Table 3. -- Urban Population, by States: 1850, 1880, 1910, and 1940 (Earlier census figures as revised for 1940)," in Leon E. Truesdell, "The Development of the Urban-Rural Classification in the United States: 1874 to 1949" no. 1 (August 5, 1949), Bureau of the Census, Department of Commerce, *Series P-23 Current Population Reports - Population Characteristics* (Washington: Government Printing Office, 1949), 15.

<sup>426</sup> "From Cordwaining to the Machine Age," in *Three Hundred Years of Shoe and Leather Making in Massachusetts* (Boston: Gill Publications, Inc., 1930), 18, MHS.

<sup>427</sup> This pattern of industrial reorganization was of course not unique to footwear production. See Hounshell, *From the American System to Mass Production, 1800-1932*.

<sup>428</sup> "Michael Cummisky," *Boston Pilot* 8, no. 25 (June 21, 1845): 200, accessed digitally via Boston College Libraries.

<sup>429</sup> Oscar Handlin, *Boston's Immigrants, 1790-1880: A Study in Acculturation*, rev. ed. (The Belknap Press of Harvard University Press, 1991); William J. Collins and Ariell Zimran, "The Economic Assimilation of Irish Famine Migrants to the United States," *Explorations in Economic History* 74 (2019), <https://doi.org/10.1016/j.eeh.2019.101302>.

need of income encouraged some shoemakers to become managers of factories, while others focused on corresponding retail operations. The emerging system was a boon to the region's expanding rubber processors, who quickly began coordinating and combining with large shoe firms in attempts to out-innovate one another and capture the budding retail market. One such merger involved the 1851 acquisition of the Malden Rubber Company by Elisha Converse who already owned Poland & Converse, a men's boot and shoe manufacturer. Converse rebranded the resulting outfit as the Boston Rubber Shoe Company.<sup>430</sup>

By 1860, storefront retail of ready-made stock was the standard way of selling footwear in cities from Sag Harbor to Saginaw to Sacramento.<sup>431</sup> Manufacturers of standard boot and shoe patterns were making use of machines for rapidly stitching leather, which allowed workers to send thousands of pairs of shoes out of the largest factories every day.<sup>432</sup> Rubbers were a common and affordable segment that complemented leather stock in winter and spring. From 1865 to 1880, producers and retailers kept prices of rubber overshoes fairly stable, while marketing them especially in "small sizes" for girls and young women. At around forty cents per pair, their cost was only one fifth of even the cheapest leather shoes they might have been used to conceal and insulate.<sup>433</sup>

Accordingly, the twin issues of wet and muddy feet as threats to health and cleanliness seemed resolved before the paved sidewalks era had even begun. Mud and slush were accepted, though certainly not embraced, as the common reality of streetscapes in any town and even in much of any city. Rubber overshoes or boots addressed that reality well enough. However, much else remained unresolved in the

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<sup>430</sup> E.D. Eldridge, *Last Century Recollections* (Boston: Boot and Shoe Recorder, undated), 10, MHS.

<sup>431</sup> For an example of retail boots and rubbers sold not only in "heavy nailed" varieties for miners but also for the women and children who lived in the hastily constructed foothill and mountain towns of California gold country, see "Boots and Shoes! Simon Mayer Has Just Received at His Stand...", *The Nevada Democrat* (Nevada City, CA), November 9, 1859, 3, CA.

<sup>432</sup> *Three Hundred Years*, 9.

<sup>433</sup> G. Lamkin's Boot and Shoe Emporium, "To the million! Seventeenth annual closing out sale...", 1866, Collection of Trade Catalogs, MHS; Advertisement, *The Portland Daily Press*, January 1, 1875, 2, CA; Advertisement for Wallace B. Fenn & Co., *Morning Journal and Courier* (New Haven, CT), November 23, 1880, 1, CA.

making of the American urban mobility landscape. Changes to sewerage, streetcar lines, road grades, and more occurred on scales that in any given city were at least visible on an annual timescale if not more rapidly. Walking in the city was changing as well and rubbers, despite having achieved a centrality that would help them remain relevant for some time, would gradually diminish in value for urban walkers after the 1880s.

For centuries, Euro-American colonizers had entrusted leather, and sometimes wood, to keep their feet clean and dry.<sup>434</sup> In the mid-nineteenth century, New England's booming footwear industry began selling imported, processed rubber as further waterproofing for Americans, who by then had specific health concerns about cold, wet feet. Rubber overshoes and tightly cinched leather ankle boots were staples of New England's production through the end of the century (Fig. 3.1).<sup>435</sup> However, after new cement infrastructures changed the standard for urban walking surfaces, leather was occasionally replaced by canvas uppers and rubber moved into a new role as the preferred tread material. Rather than protecting feet from unhealthy damp, rubber was gripping concrete and launching these pedestrians who could already navigate cities faster, neither puddle-jumping among cobbles nor shuffling over ice-covered bricks in between rides on electric streetcars and gas-powered automobiles.

In 1873, Diocletian Lewis, a public figure who opined on health matters under the name Dr. Dio, expressed strong opinions on girls' footwear. His writing on the topic was reprinted in newspapers throughout New England and beyond. According to Dr. Dio, girls' shoes were made too narrow, a style Lewis blamed on the fashion taste of the girls, though he acknowledged that many shoemakers themselves might bear responsibility, given the new retail age. Regardless, Lewis warned that narrow shoes caused "unsteadiness, sideways vibration," and prevented getting a solid push forward from each step. Bringing to mind footwear as part of a physiological system, he further contended that "pressure of

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<sup>434</sup> *Three Hundred Years of Shoe and Leather Making in Massachusetts* (Boston: Gill Publications, Inc., 1930), 5-23, MHS.

<sup>435</sup> For a representative example, see Massachusetts Boot and Shoe Co., *Fall and Winter Price-List for Season 1885-86* (Boston: Boot and Shoe Recorder, 1885), Trade Catalogs, HBS.

the upper leather checks the circulation in the foot and makes it cold.” His lectures were reminiscent of the rubber endorsements that, many decades earlier, had castigated females for shoe choices.

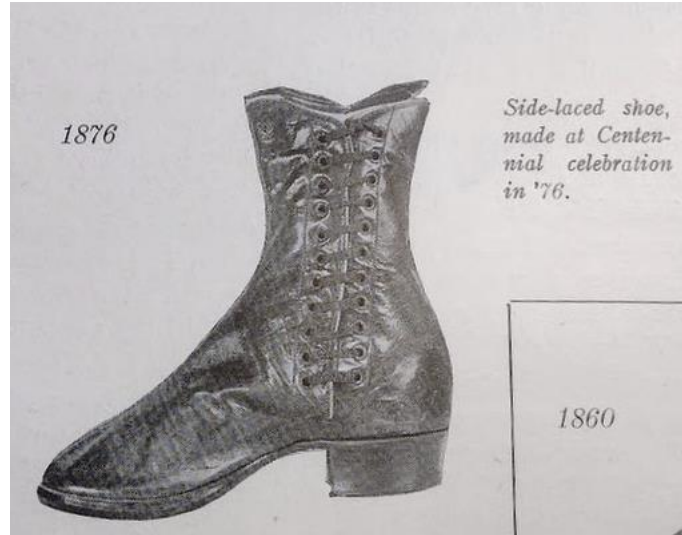


Figure 3.1. An 1876 side-laced boot as example of “Bygone Fashions in Boots,” in *Three Hundred Years of Shoe and Leather Making in Massachusetts*, 1930. Viewed at the Massachusetts Historical Society.

Dr. Dio sarcastically wondered if women’s footwear remained impractical because shoemakers thought females somehow levitated instead of making contact with “the damp unclean earth.” Lewis countered that women did in fact make tracks and were “not always to remain upon carpets, but they must go outdoors and walk on the ground.” For that, they needed thickly soled boots and shoes “of the hardest and most impervious leather.”<sup>436</sup> He was as clear as other men were at the time that getting clothing wet was a threat to a woman’s health.<sup>437</sup> Lewis mentioned neither that rubber already had a conspicuous role in these matters, nor that stone or brick sidewalks, where they existed, offered literal intermediate steps between carpet and soft earth.

<sup>436</sup> “Girls’ Boots and Shoes,” syndicated excerpt from Diocletian Lewis, *Our Girls*, reprinted in *Oxford Democrat* (Paris, ME), June 17, 1873, 1, CA.

<sup>437</sup> Daniel M. Fisher and Samuel E. Warren, “Improvement in Wash-boards,” US Patent No. 189,618, filed October 20, 1876, and issued April 17, 1877.

In the 1860s and 1870s, most blocks in most cities did not have paved walks of any kind. These structures remained a luxury. In Maine's capital, Augusta, cries of profligacy erupted in 1871 after a rumor spread that the city had initiated and paid for the new and conspicuously wide asphalt sidewalk along one side of several blocks on a major street. The local newspaper, the *Kennebec Journal*, attempted to correct the misinformation by sharing that, in fact, a group of property holders on that side of the street had requested the project and had assumed most of the expense. Many writers and editors of local news were vociferous champions of public works, and at least one such person worked for the *Kennebec Journal*. The rebuke to sidewalk criticism went on to chastise opposition to any improvements, from the grading and regrading of streets to the laying of drainage tiles and sewer pipes. Furthermore, the paper advocated extending the new sidewalk out to Augusta's cemetery. If made as wide as the existing segment, then the horsedrawn hearse and carriages of funeral processions could use that path instead of the roadbed, which was always rough and in bad weather required switching horses into studded shoes. These conditions were embarrassingly averse to cultural practices of visiting the dead, the paper reported, because they too often left the route "almost impassible [*sic*]" even for those going by foot.<sup>438</sup>

Pedestrians found similar issues of dirty streets and intermittent board sidewalks in towns across the country. The unpaved, often muddy streets of Montana, for instance, were especially offensive to women of a particular class and cultural upbringing.<sup>439</sup> That group was a small minority of the Americans who lived in Montana's territorial era, but it was a group that included figures like Mary Wright Edgerton, the first governor's wife. Women like Mrs. Edgerton adhered to long dress styles, in part as a way to feel connected to relatives and grounded by a fashion-based feminine identity.<sup>440</sup> Long dresses limited women's freedom to leave their homes, because the filthy or muddy condition of Montana's unpaved

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<sup>438</sup> "Local and State News," *Daily Kennebec Journal* (Augusta, ME), August 4, 1871, 3, CA.

<sup>439</sup> Lore Ann Guilmartin, "Textiles from the Steamboat Bertrand: Clothing and Gender on the Montana Mining Frontier" (PhD diss., Texas A&M University, 2002).

<sup>440</sup> Allison Badger, "'Little Bit of Paradise': Women's Search for Comfort in Late-Nineteenth Century Montana" (MA thesis, University of Montana, 2003).

streets assaulted and dirtied the lower hems of items they cherished, or that they at least held responsibility for laundering. In 1866, Virginia City resident Sallie Herndon noted several occasions in her diary when ground conditions had interfered with church attendance, both her own and other women's. That October she logged, "The streets are awful muddy, haven't been down street for a week."<sup>441</sup>

In the 1870s, hope for these women to remain both mobile and clean came via their many connections to people and places elsewhere across the country. At the time, the rate of new sidewalk construction was already picking up in many American cities, though not so much as in the cement concrete era that was still to come. Through the 1880s, the material used for these sidewalks was quite variable. In a given city, pedestrians might tread upon gravel, cinders, wooden planks, bricks, granite pavers, flagstones, and mixtures analogous to what we now call asphalt, often encountering several different surfaces within only a few blocks of travel. "Concrete sidewalks" at the time somewhat confusingly referred to that asphalt-like material, in which bituminous or oily binders held gravel together and in place. These were welcomed in small New England cities like Augusta, Maine, even before they gained national attention at Philadelphia's 1876 Centennial Exhibition. One reporter visiting that fair from Montana praised new walkways along the Schuylkill River by calling them "as soft and pliable to the foot as velvet, and swept and kept as cleanly as a lady's boudoir."<sup>442</sup> Too soft, as it turned out. In addition to becoming slick when wet, in warmer weather these surfaces were liable to become sticky, much like non-vulcanized rubber.<sup>443</sup>

### Streetcars and the Less-Walking City

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<sup>441</sup> Sallie Raymond Herndon, "October 18, 1866," 1866 Diary, as quoted in Guilmartin, "Textiles from the Steamboat Bertrand."

<sup>442</sup> Helen E. Taylor, "Sights at the Centennial," *Helena (MT) Weekly Herald*, October 19, 1876, 3, CA.

<sup>443</sup> On the slickness of wet asphalt before the 1890, see Gabriel Lee, "Concrete Dreams," 98.

Counterintuitively, the construction of more sidewalks began in an era of walking less. They fit within a broader project characterized by speeding up mobility around cities and lessening exposure to natural elements, each of which both shaped new class distinctions and supported a general sense of progress in modern cities. Unlike the subsequent work of paving sidewalks, the grading of city streets and the establishment of streetcar lines were activities in which civil engineers and transportation company officials connected infrastructures across the urban landscape with the goal being one cohesive network of mobility. This process reset the landscape of walking in American cities. In Portland, Maine, it began in the 1860s, and there it echoed the same process in Boston that was famously chronicled by the social historian of American urban development Samuel Bass Warner.

Warner described Boston as a “walking city” in 1850. The term describes not only how people got around but also the physical plan of the metropolitan area. The dense arrangement of streets and buildings was fairly typical of American cities at the time and reflected what Warner called “a temporary compromise” among diverse residential and commercial desires and realities.<sup>444</sup> A major constraint on that compromise, and therefore what kept most urban residents concentrated together, was the fact that most people walked to all their daily destinations. The Boston area was characterized by its densely populated harbor peninsula and peripheral town centers that had smaller populations but with similar density. The population of Portland, Maine, was likewise confined to a peninsula with compact streets where areas for industry, commerce, and residence had little meaningful separation. Some may have desired, for example, more privacy and quiet in their residence, but they needed to balance that against a convenient walking distance. The only people free from such trade-offs were those who could afford horses and carriages and thereby reside farther from the commercial or industrial centers.

In the middle of the nineteenth century, private companies formed to recast the landscape of urban mobility by laying steel rails in the middle of streets. Many received licensure from municipalities

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<sup>444</sup> Warner, *Streetcar Suburbs*, 15, 21.

to do just that, as well as to run their own horsedrawn cars along the rails and thereby provide the carriage form of travel to a much broader swath of the urban population. These street rail networks, much more so than the omnibus carriages and steam railroads that slightly preceded them, allowed middle-class professionals and even some industrial laborers as well as their families to live farther from their workplaces, schools, and markets. The streetcars, along with new telegraph lines, maintained a cohesion of the industrial city even while facilitating dispersal of the city's people into what had been outlying townships or villages.<sup>445</sup> By the 1860s, significant construction around Boston was occurring in newly developed areas beyond the city's boundaries. As Warner documented, around Boston this led to a suburban form of development in Roxbury and Dorchester, which had been distinct municipalities but were annexed into the city amid streetcar expansion.

A similar process, though somewhat delayed and quite protracted in comparison to Boston, took place around Portland. Portland's major annexation of inland Deering did not occur until after the ceremonious and dramatic electrification of local streetcars on January 1, 1896. The cars of the Portland Railroad Company, which operated the entire network (Fig. 3.2), were horsedrawn from the first ride in 1863 until December 1895 when, on the eve of electrification, the company owned 50 cars and 225 horses.<sup>446</sup> In a city with fewer than 40,000 residents, the streetcars could carry more than two percent of the entire population at any given moment on a workday. Adding omnibuses, individual carriages, and interurban rail lines to the mix, this was no longer the walking city of old. Electrification reinforced streetcars as a major mode of transit, and it reinforced the new, diffuse form of city development. Warner noted that electrification made street rail transport convenient to a range of six miles from Boston's City Hall, as opposed to the two-mile range that the horsedrawn cars reliably served soon after their start there in 1852.<sup>447</sup> The newly electrified Portland network reached some five miles inland from the city center

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<sup>445</sup> Warner, 16.

<sup>446</sup> Edwin B. Robertson, *Remember the Portland, Maine Trolleys* (Westbrook, ME: Robertson Books, 1982), 8, PR.

<sup>447</sup> Warner, 22.

and pervaded the soon-to-be-annexed Deering. The Deering landscape included more distinctly zoned uses, with long residential streets coming off commercial arteries along which the streetcar rails provided access to light industrial hubs at Deering junctions and the heavier industrial areas of Portland proper.

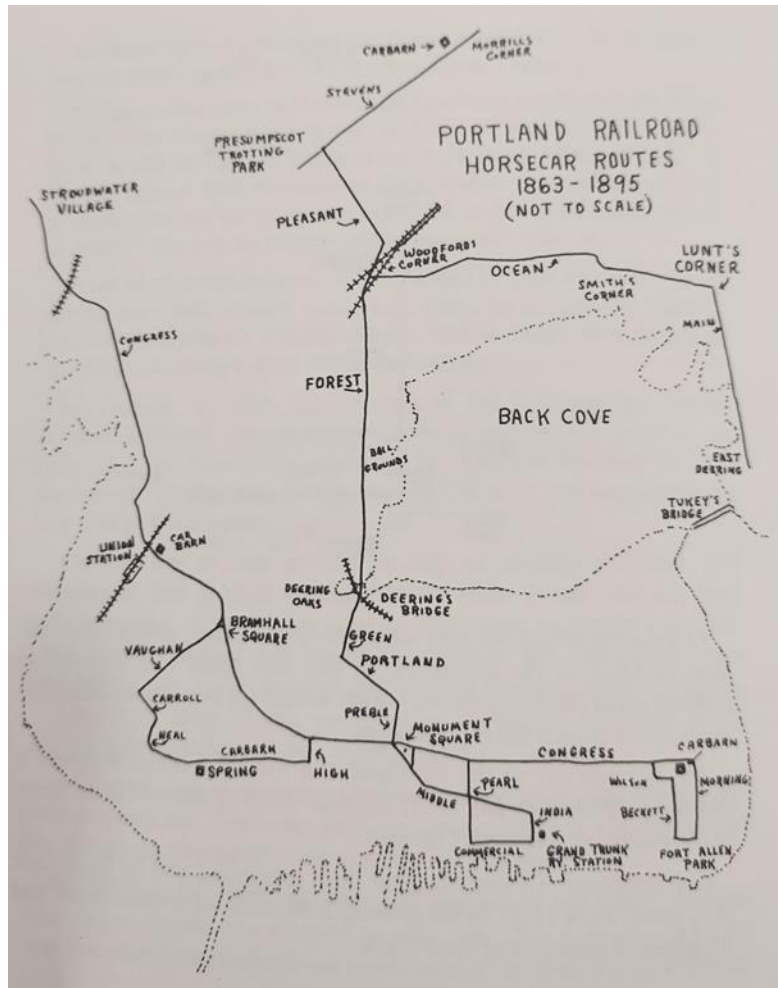


Figure 3.2. Map of streetcar routes in Portland, Maine, up through the system's January 1896 electrification. The map is slightly rotated, meaning the dotted line of wharfs at the bottom in fact runs northeast to Fort Allen Park. That waterfront and the bottom of Back Cove here form the long sides of the peninsula that defined Portland's city limits in this period, with the central Congress Street ascendant as a commercial and cultural corridor. Most of the rest of the map is Deering, the area of streetcar suburban development adjacent Portland proper. Recreated by Edwin B. Robertson and published in *Remember the Portland Trolleys* (1982).



Figure 3.3. Preparation for solid street surfacing on Portland Street (now Park Avenue) between Forest and Deering Avenues, Portland, Maine, 1904. Two carriage lanes, until then gravel and for the moment dirt, were divided by the existing streetcar rails and electrification, which was itself at most eight years old at the time. A smooth sidewalk, likely concrete, is also visible on the edge of Deering Park to the left.

The effects of well-developed streetcar routes on 1890s concrete sidewalk construction were several and somewhat conflicting. On the one hand, as noted, walking was less relied upon by city residents as a singular mode of transportation. In this way, the street rail system might have diminished the need for pedestrian infrastructure. Yet on the other hand, streetcar travel still entailed walking outside in the city. In fact, the clean and quick streetcar had encouraged development along miles upon miles of new streets that were, at least initially, unpaved, unsewered, and occasionally even ungraded stretches of earth. Even on some of the streets that featured trolleys, a pair of steel rails, typically embedded in granite

and cement, was among the only improvements (Fig. 3.3).<sup>448</sup> It was on these variously unimproved blocks that many Deering riders began toward a shopping district or workplace or meetinghouse, at which they would also need to take at the very least a few paces from the set streetcar stops to reach their final destination.

In some ways, streetcars were inimical to pedestrians. This was true of the electrified cars in particular. Hoping to spare pedestrians the too often realized fear of personal endangerment by streetcar, as electric cars went online several municipalities established their first speed limits, sometimes six or seven miles per hour but sometimes eschewing quantification and instead outlawing any rate deemed to have caused harm.<sup>449</sup> But even the old horsedrawn cars caused the type of conflict that had made sidewalks appealing in the first place. That problem stemmed from the placement of rails, which often ran either right down the middle of the street or just off the center line.<sup>450</sup> Graded dirt roads, like all improved streets, were typically beveled toward edges that served as de facto gutters even if no gutter structures existed. Pedestrians therefore sought out the higher middle ground to traverse streets that were muddy or puddled but lacked sidewalks, as was true of many streets outside central business districts or in newly developed areas.<sup>451</sup> Because heavily trafficked roadbeds could be so rutted and puddled, many cities paved crosswalks at major intersections before they paved those streets (Fig. 3.4).<sup>452</sup> Taking the middle of

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<sup>448</sup> Multiple illustrations, including the photograph above, are found in Office of Commissioner of Public Works, *City of Portland, Annual Report of the Commissioner of Public Works, 1904* (Portland, ME: Marks Printing House, 1905), PWD.

<sup>449</sup> *Charter and Ordinances of the City of Lewiston* (Lewiston, ME: Le Messenger Office, 1894), 143, BRL; *Charter and Ordinances of the City of Westbrook, and By-Laws of the Local Board of Health* (1907), 43, BRL; Charles D. Heseltine, "History of the Portland Railroad Company," 1946, PR.

<sup>450</sup> Charles D. Heseltine, "Bangor Street Railway," *Transportation Bulletin* no. 81 (1974), as republished in bound volume (Warehouse Point, CT: Connecticut Valley Chapter, National Railway Historical Society, 1976), 23-24, 36, BRL.

<sup>451</sup> For one example of the "middle ground" language, see John Smith to the Hon Mayor and City Council, June 25, 1895, "Petitions" (re building repairs, use of auditorium, use of city rock crusher, bicycles on sidewalks, herding of cattle, boys hanging out at opera house, telegraph lines, garbage collection) – 1895, LG 1, box 2, folder 3, Helena (Mont.) City Clerk Records, 1881-1918, MTLA.

<sup>452</sup> The quantity of "Crosswalks" material, overwhelmingly meaning small granite pavers, was in fact recorded separately from both "Street Pavements" and "Sidewalks" in the Portland, Maine, annual public works reports. See, for example, Office of the Commissioner of Public Works, *City of Portland, Annual*

the road had always been a bit risky for pedestrians, but now with the combination of streetcars in addition to horses, walking that path was disadvantageous to everyone involved. The justification for building sturdy sidewalks therefore included safety *from* the streetcars as well as clean and unobstructed access *to* them.

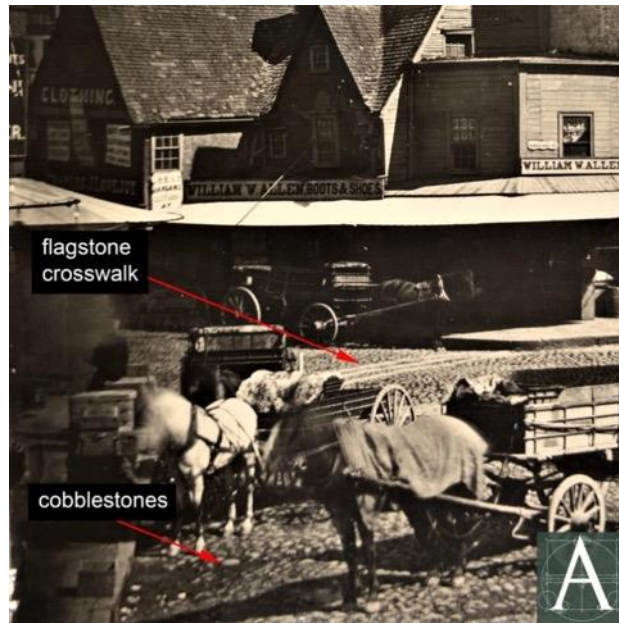


Figure 3.4. Cobblestone street paving with crosswalks of flagstone at Dock Square, Boston, Massachusetts, ca. 1860. This particular arrangement of surfaces had been maintained for at least two decades, and it demonstrates the preferential pavement of crosswalks that would remain common into the concrete sidewalk era. Image courtesy of Historic New England, via Archipedia New England.

### Sewers, Cement, and Civil Engineers

Though pedestrians had their rubbers as protection, comparison to modern city conveniences like the streetcar no doubt increased frustration with what continued to be a dynamic ecology of urban walking. City street surfaces were especially unpredictable after weather events, sometimes pushing the limits of overshoes and boots. That was the case following a storm that hit southern Maine in late November of 1888. The two-day storm included heavy precipitation that in many locations transitioned

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*Report of the Commissioner of Public Works, 1910* (Portland, ME: Marks Printing House, 1911), 34, PWD.

from snow to rain. The *Biddeford Daily Journal* reported slush everywhere in that mill city, including “nearly knee deep” accumulations on several main streets that did in fact already have some form of sidewalk, likely brick or stone.<sup>453</sup> The paper’s writers amused readers with pedestrian “mishaps” recounted as vignettes that smacked of sensationalism and yet no doubt contained some true and relatable themes. Reportedly, a girl dumped a pitcher of milk after “her foot disappeared in a hole filled with slush.” A city official first lost his fine beaver hat into the muddy gutter water and then, focused on retrieving it, let a gust of wind carry off his expensive silk umbrella. Two ladies, overdoing their politeness to one another, simultaneously stepped off a walk and into slush that instantly overtopped their boots. A girl’s feet both slipped, leaving her sitting in a slushy pool before she gathered herself and “resumed her journey with dripping skirts and a distressed look on her face.”<sup>454</sup> Footwear, clothing, and accessories intermixed with manners and municipal infrastructures and weather to make Biddeford’s walking experiences what they were that day.

Mixed precipitation storms were typical of the winter months on the northern New England coast. Nonetheless, the *Journal*’s staff deemed the mishaps largely avoidable. Wisely giving nature a pass, they editorialized that sidewalks and crosswalks and drainage infrastructure were supposed to work in conjunction with civic responsibility and personal preparedness to make walking as dry as possible.<sup>455</sup> Most pedestrians, many of whom were mill hands in the city’s factories and perhaps some employed by York County Fine Shoes, had done their part by “taking the wise precaution to wear rubber boots.”<sup>456</sup> Yet

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<sup>453</sup> “Biddeford’s Streets,” *Biddeford (ME) Daily Journal*, November 27, 1888, 3, CA.

<sup>454</sup> “Sunday’s Storm: It Still Continues with No Prospect of Abatement” and “Incidents of the Slush,” *Biddeford Daily Journal*, November 27, 1888, 3, CA.

<sup>455</sup> By considering the unequal experiences of this storm and sympathizing with those whose hardships were clearly not their own faults, the Biddeford writers’ opinions, quaint as they now may appear, resonate to some extent with recent scholarship headlined by the edited volume, Chester Hartman and Gregory D. Squires, eds., *There is No Such Thing as a Natural Disaster: Race, Class, and Hurricane Katrina* (New York: Routledge, 2006).

<sup>456</sup> Advertisement for York County Fine Shoes, *The Lapeer (MI) Democrat*, December 10, 1884, 8, CA; Photograph of Biddeford Weekly Advance Building with signage “York County Fine Shoes,” November 17, 1880, digital collections of the Biddeford Historical Society, <https://biddeford.catalogaccess.com/photos/1324>, accessed February 23, 2025.

many still had endured “the plague of wet feet.” The *Journal* found this unbecoming of a “city the size of Biddeford.” Property owners in a modern municipality were supposed to cooperate with infrastructure by promptly shoveling their respective stretches of sidewalk, and the paper argued the city’s officials should have enforced the same in addition to clearing the crosswalks of public streets.

In this emerging view, the responsibility for keeping feet dry was distributed among the pedestrians, their footwear, the property owners, the city officials, and the walking surfaces themselves. While the first two were well established, the final three represented the new technologies of urban infrastructure, in which cement was beginning to take a significant role. In this emerging constellation of foot protection, cement infrastructure and concrete sidewalks in particular had an opportunity to affect cultural developments in American cities. To illustrate what those opportunities looked like and how cement shaped cultures, this chapter focuses primarily on the case in New England.

Whether they knew it or not, people walking around New England cities in the 1870s and 1880s had cement underfoot. This cement was not visible from the street. Instead, it was buried some six to ten feet underground in the form of new sewer pipes. These sewer systems were the commensurate drainage routes that, to frequent chagrin, lagged significantly behind the water supply systems that many cities had built to pipe *in* relatively clean water.<sup>457</sup> Portland, Maine, was no exception, finding itself without a sewer system even after the city began piping water from nearby Lake Sebago into residents’ homes. Water was arriving without a plan for where it ultimately went and how it got there. Accordingly, the City Civil Engineer, William A. Goodwin, was handed the additional title of Superintendent of Sewers. By this authority, Goodwin directed workers to begin digging around the existing Sebago delivery pipes and inserting tubes to shed wastewater off the peninsular city.<sup>458</sup>

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<sup>457</sup> Joel Tarr, *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective* (The University of Akron Press, 1996), xxxvii.

<sup>458</sup> William A. Goodwin, *Annual Report of the Civil Engineer to the City of Portland, March 4, 1879* (Portland, ME: Tucker Printing House, 1879), 10-14, PWD.

A fair number of bricks and lengths of vitrified clay piping went into this project, but cement's importance quickly grew. What better material for conveying filthy water than this durable and relatively impermeable substance? In 1878, Goodwin's crew put nearly two hundred feet of twelve-inch cement pipe under Brown Street, in nearly the exact center of town. By the end of the year, the nascent sewer systems had bookends: a 310-foot cement pipe under Danforth Street on the west side and another 564-foot under Munroe Street on the east. Another four projects brought the total length of new cement pipe laid that year to over 2,000 feet. Through the 1880s, the lengths and sizes of sewer pipe grew; the City laid one mile in 1889, all of it cement.<sup>459</sup> In the same decade, cities around the region and beyond were undertaking similar projects. In Boston, not surprisingly due to the aforementioned annexations and a population ten times as large, the scale of sewer construction and cement use dwarfed Portland's. In 1883, Boston completed the final two thousand feet of a single sewer tunnel that ran more than one and one-third miles from Dorchester out into Quincy Bay. Though the bulk of the sewer's volume was brick, the City Engineer calculated that the structure incorporated 23,377 barrels of cement, or nearly 4,400 tons.<sup>460</sup>

Even in a more modest city like Portland, cement was accumulating underground. After the 1890 construction season, Portland had nearly 200,000 feet of sewerage variously consisting of brick, clay, stone, wood, or the entirely cement pipes first laid in 1878. Some 87,000 feet was now cement pipe, a plurality quickly approaching a majority.<sup>461</sup> Besides constituting new sewer systems, cement also lined the underground cisterns that were one component of public safety responses to urban fires.<sup>462</sup> These were perhaps more trustworthy than the older cistern construction that would later give way beneath Mr. King.

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<sup>459</sup> William A. Goodwin, *Annual Report of the Civil Engineer to the City of Portland, March 7, 1881* (Portland, ME: Ford & Rich, 1881), 5-11, PWD; William A. Goodwin, *Annual Report of the City Engineer, Portland, Maine, 1890* (Portland, ME: Brown Thurston Company, 1890), 15, PWD.

<sup>460</sup> Office of the City Engineer, *Seventeenth Annual Report of the City Engineer, for the year 1883* (Boston: Rockwell and Churchill, City Printers, 1884), 45-46, MHS.

<sup>461</sup> William A. Goodwin, *Annual Report of the City Engineer to the City Council for the Year 1891* (Portland, ME: Brown Thurston Company, 1892), 24, PWD.

<sup>462</sup> "Minor Items," *The Weekly Miner* (Butte, MT), December 7, 1880, 5, CA; "Notice," *The Anaconda* (MT) *Standard*, September 28, 1890, 8, CA.

The new, cement-sealed cisterns were common in cities across the United States, and even city engineers in locales where portland cement was at times quite expensive used the material at least for joints between vitrified pipes.<sup>463</sup> Still, people in most US cities did not regularly see or otherwise encounter cement infrastructure as they would in the decades to come.

### Artificial Stone Sidewalks

Today, after more than a century of concrete sidewalks as a standard component in broader and generally effective systems of pavement and drainage throughout municipalities, it is difficult to imagine just what a contrast a well-built sidewalk provided to other walking options at the end of the nineteenth century. Portland was like many smaller cities and towns in the East that had a good number of filthy, instable, and puddle-prone streetscapes that were like those in much newer cities in the West. Cities in the West were also early enough in the formation of their governance that the process of sidewalk construction was often laid bare in disputes between residents, contractors, and municipal officials over the proper process, materials, and payments. For these reasons, some westward glimpses provide perspective on how, in fits and starts, concrete walks came to exist across the country.

When Montana city councils first ordered property owners to pave sidewalks, they often targeted only the busiest commercial blocks. In June of 1888, the council in the territorial capital of Helena read an ordinance specifying sidewalk construction of “stone, brick, or cement, eight feet wide for Main Street and part of Broadway” while other streets should have five-foot wide boardwalks. While this decree went into effect for the downtown, a process also existed whereby other blocks might gain more permanent walks. This was the petition system, already noted in the case of Helena, Montana, where it was set forth in the 1881 amendments to the city’s articles of incorporation as Article VII – Public Improvement. The

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<sup>463</sup> “The Sewerage Question,” *Helena Weekly Herald*, June 17, 1886, 5, CA; “City Council: Bids Opened for Furnishing the City with Sewer Pipe, Cement and Vitrified,” *The Helena (MT) Independent*, July 2, 1889, 4, CA.

article allowed “any reputable holder of property” to request construction or reconstruction on a city street. At that point, public works officials were charged with determining whether a majority of effected property holders were amenable to the projects and the associated assessments.

Amid the new popular confidence in the work of civil engineers, it seemed to many city residents that sidewalk and drainage technologies, properly funded and properly deployed, could tame the urban environment regardless of what fell from the sky. Petitioners for sidewalk construction in the 1880s portrayed themselves as helpless victims overexposed to the elements of dirt and water.<sup>464</sup> By the early 1890s, many Helena property owners had begun more coherently petitioning the mayor and council to extend sidewalks, in any form, beyond the few blocks of Main Street where they had long existed. One petitioner called the lack of constructed walking paths “a serious inconvenience” and another regarded the remedy “of pressing public importance.”<sup>465</sup> Other petitions called for complementary structures including culverts, retaining walls, and catch basins that would impede or channel the movement of water and sediments and thereby keep roads passable to the degree pedestrians were coming to expect.

By 1890, Portland, Maine, had enough precedent for sidewalk construction and for public improvements in general that not all projects required petitions. Through that year, City Engineer William Goodwin led a department overwhelmingly focused on building sewers in addition to its ongoing work to grade streets and mark the public right-of-way’s boundary with square granite monument stones.<sup>466</sup> Surely, Goodwin and other officials also involved themselves in matters concerning the many lengths of

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<sup>464</sup> Resident Taxpayers Residing in Hoback and Cannon’s Addition to the Honorable, the City Council of the City of Helena, Montana, “Petitions” – 1887, LG 1, box 1, folder 6, Helena (Mont.) City Clerk Records, 1881-1918, MTLA; “Undersigned Property Owners” to “The Honorable Body the Mayor and City Council of Helena,” May 2, 1887, “Petitions” – 1887, LG 1, box 1, folder 6, Helena (Mont.) City Clerk Records, 1881-1918, MTLA.

<sup>465</sup> To the Hon. the City Council of the City of Helena, Mont. [from] the undersigned citizens and property owners, “Petitions” – 1887, LG 1, box 1, folder 6, Helena (Mont.) City Clerk Records, 1881-1918, MTLA; To the Hon. the City Council of the City of Helena [from] your petitioners, “Petitions” – 1887, LG 1, box 1, folder 6, Helena (Mont.) City Clerk Records, 1881-1918, MTLA.

<sup>466</sup> Office of the City Civil Engineer, *Annual Report of the City Engineer, Portland, Maine, 1890* (Portland, ME: Brown Thurston Company, 1890), PWD.

flagstone, granite, or brick sidewalk through the city's core, but they did not deem that activity worth inclusion in their annual report. That would change the following year. In the fall of 1891, the city engineer's office found itself doing so much sidewalk work that it created a "sidewalk assessment book" to log projects. The book also aided complicated calculations by which the owner of abutting property paid around one quarter of the costs to emplace curbing and lay thousands of bricks for a sidewalk typically eight to ten feet wide.<sup>467</sup>

Incidentally, the assessment book began to record details of a grand, if somewhat disjointed, public works effort that would remake and extend solid walking surfaces in Portland. The 1891 sidewalk assessments uniformly involved brick construction along older streets on Portland's two-and-a-half-by-one mile peninsula. Most of these streets either paralleled the long axis, such as the central Congress Street running along the peninsula's saddle between its two escarped ends, or paralleled the short axis, such as the historic Franklin Street that ran up and over the saddle from the bay-facing commercial wharfs on one side to the tidal lagoon on the other. The sidewalk project began as a rationalization and codification of pedestrianism on those streets by way of brick. But it soon transformed into a project of remaking select stretches with concrete while extending the presence of sidewalks out into newer residential areas.

In 1894, City Engineer George N. Fernald allowed some property owners to contract with private crews who laid the first recorded public concrete sidewalks in Portland. The contracts likely went to Judah Drysdale's Portland Sewer Pipe and Artificial Stone Company, which the preceding fall had begun advertising its ability to create sidewalks in addition to concrete caskets that gave the dead "a convenient and permanent home."<sup>468</sup> Just how the City and abutters should share the cost of artificial stone took enough time to determine that Fernald could not account for it in that year's report, which included public

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<sup>467</sup> "City of Portland Sidewalk Assessment Book," 1891-1933, PWD.

<sup>468</sup> "Sarcophagus," *The Portland Daily Press*, September 25, 1893, 8, CA.

expenditures on brick and wooden walks down to the penny.<sup>469</sup> The property owners who had gone out of their way to secure concrete sidewalks were on only three streets in two neighborhoods. One street was Western Promenade, which had on one side several large and distinguished homes and on the other an eponymous park affording views of New Hampshire's White Mountains. In subsequent years, the park itself would come to have an end-to-end concrete walking path, though when exactly is unclear because the annual municipal report did not always name materials used within city lots in the way it uniformly did for true sidewalks along streets.

The other two streets were Washburn Avenue and Roberts, just then being developed into a small residential section on Portland's border with Deering. The new structures on this cluster of blocks included some single-family homes and many others intended for occupant owners to share with a renter on an upper floor. They were likely a step up in space and privacy from rentals in the neighboring Irish enclave of Libbytown or closer to downtown, but unlike on Western Promenade, these were not homes with a carriage house and a porte-cochère. To reach the closest trolleys on Congress Street and get to nearby Union Station just across it, residents walked at least a third of a mile. By the end of 1894, three hundred and thirty feet of that walk might have been made atop concrete.<sup>470</sup> By square footage, the neighborhood had three-fourths of the new cement sidewalks in Portland. Beside some new concrete sidewalks, what held together decidedly middle-class Washburn and Roberts with the august Western Promenade homes was their access to greenspace, at least relative to the city center. Though no public park sat across the street, residents on Washburn needed only walk a few blocks to reach curvilinear paths beneath the striking trees that gave fifty-acre Deering Oaks its name (Fig. 3.5).<sup>471</sup>

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<sup>469</sup> City Engineer's Department, *Annual Report of the City Civil Engineer, Portland, Maine, 1894-95* (Portland, ME: William M. Marks, 1895), 24-25, PWD.

<sup>470</sup> *Annual Report of the City Civil Engineer, Portland, Maine, 1894-95*, 24, PWD.

<sup>471</sup> Elizabeth Igleheart, "Deering Oaks," Cumberland County, Maine, National Register of Historic Places Inventory/Nomination Form, Maine Historic Preservation Commission, Augusta, September 15, 1989; B. Bradbury, "Deering's Oaks 1895," Map F776, BRL.

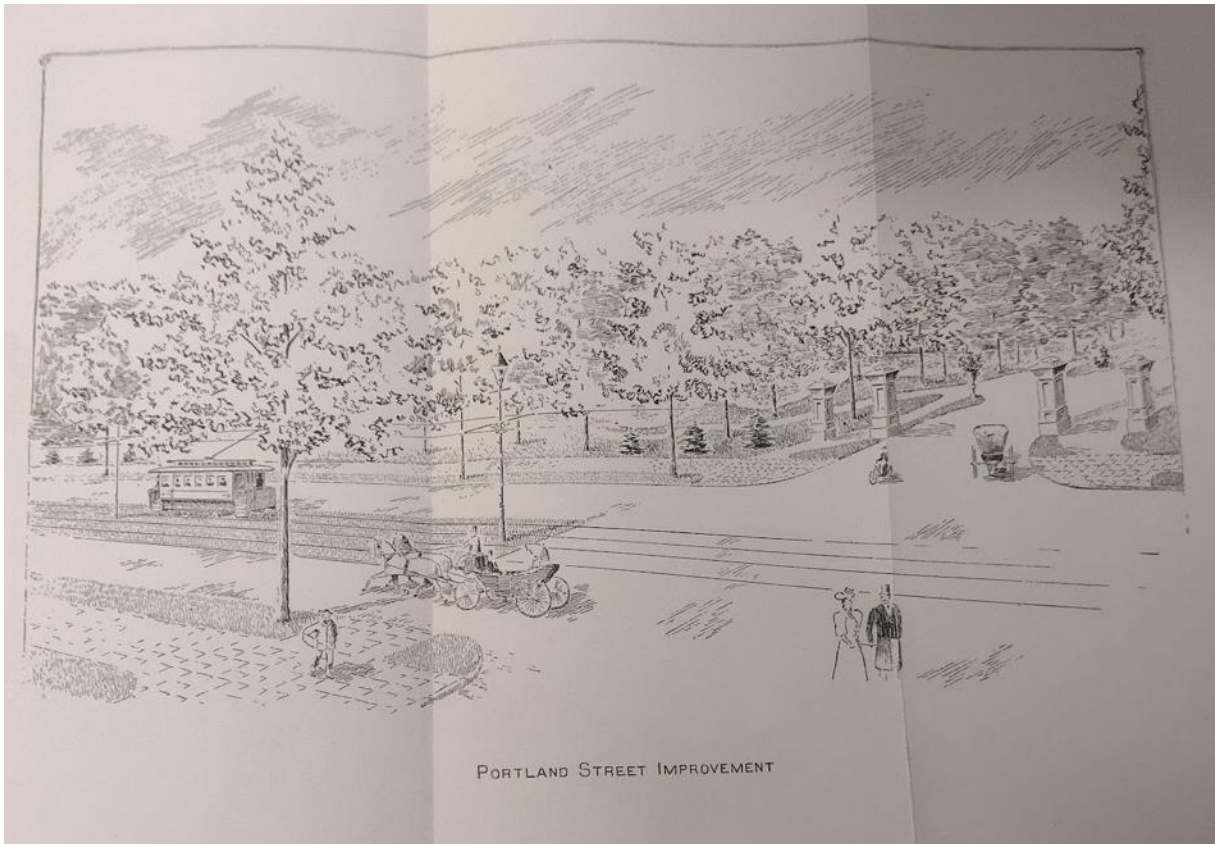


Figure 3.5. Sketch of a proposed street widening project on Portland’s eponymous street (now Park Avenue), showing in the background one entrance to Deering Oaks with its many winding walking paths. Published in *Annual Report of the Commissioner of Public Works, Portland, Maine, 1895-96*.

Proximity to parks continued to be one discernible pattern in the placement of concrete sidewalks within Portland.<sup>472</sup> The following year, City Engineer Fernald’s department undertook extensive preparations to lay walks of “cement concrete”—distinguished from asphalt concrete—in Fort Allen Park, which with the adjacent Eastern Promenade constituted a third swath of intentional greenspace in Portland.<sup>473</sup> In the context of American landscape architecture, these three were an interesting case of

<sup>472</sup> For more on the approach to city parks by William A. Goodwin, many influential Portland landowners, and the city itself, and how streets improvement, including sidewalk construction, was integrated in those developments from 1879 through at least 1905, see Earle G. Shettleworth, Jr., “Creating and Preserving Portland’s Urban Landscape, 1885-1925,” in Joseph A. Conforti, ed., *Creating Portland: History and Place in Northern New England* (University of New Hampshire Press, 2005), 253-261.

<sup>473</sup> Office of the Commissioner of Public Works, *Annual Report of the Commissioner of Public Works, Portland, Maine, 1895-96* (Portland, ME: The Thurston Print, 1896), 6, PWD.

local interpretations and adjustments in the wake of the national city park movement headlined by Calvert Vaux and Frederick Law Olmsted. Deering Oaks in particular blended ideas of egalitarian access to a revitalizing nature with practicality. Portland purchased the already well-arbored estate in 1879 in exchange for future tax breaks and rather than contracting with Olmsted allowed its own city engineer, William Goodwin, to design and gradually execute the desired paths and ponds.<sup>474</sup> In the context of thinking about clean and reliable urban walking, the three park units demonstrate how much maintenance could be saved and how much benefit gained by emplacing cemented sidewalks. This did not come without time, effort, and money. In the case of Fort Allen's new walks, though they were approved in spring of 1895, no cement was laid that year. The entire working season was spent grading terrace and laying gravel substrate that would prevent the formation of ice, which could heave or even crack the concrete walks from below.<sup>475</sup>

This explanation of concrete sidewalks' substructural requirements contributed to what would be the last annual report in which the public works department described park projects in such detail. Fernald was overseeing such an acceleration of street work that there was perhaps not time for explaining recreational trivia. In 1895, crews laid nearly as much new curbstone (8,576 feet) as they had in the three previous years combined.<sup>476</sup> The building and repairing of sidewalks accounted for one-seventh of the swelling streets work budget.<sup>477</sup> Portland spent only a small fraction of that for laying concrete sidewalks, half as much as for laying wooden walks and one-twentieth of the expenses for laying brick sidewalks. The new concrete walks were about equal in extent to those laid the year before, yet they included a significant development.<sup>478</sup> In addition to another 274 feet of artificial stone walks along Western

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<sup>474</sup> Igleheart, "Deering Oaks," National Register of Historic Places Inventory/Nomination Form, 1.

<sup>475</sup> *Annual Report of the Commissioner of Public Works, Portland, Maine, 1895-96*, 7-8.

<sup>476</sup> Office of the Commissioner of Public Works, *City of Portland 1897-98 Annual Report of the Commissioner of Public Works* (Portland, ME: The Thurston Print, 1898), 40, PWD.

<sup>477</sup> *Annual Report of the Commissioner of Public Works, Portland, Maine, 1895-96*, 39.

<sup>478</sup> *Annual Report of the Commissioner of Public Works, Portland, Maine, 1895-96*, 43.

Promenade, crews laid down eighty feet of the material on Congress Street.<sup>479</sup> Congress was then taking over as Portland's commercial corridor, with its centrality in the soon-to-be-electrified streetcar system encouraging a shift of businesses away from the old port.

Portland's annual public works report stated that "demands made for new sidewalks in 1895 were greater than for any year in the history of the department." City Engineer Fernald said this demand, in the form of requests from specific property owners, accounted for the great majority of sidewalk construction, far exceeding his own supplemental orders for new walks.<sup>480</sup> Within the burgeoning streets work and alongside the new sidewalk construction, which could not keep up with demand, there were many brick sidewalks in need of relaying.<sup>481</sup> This constituted a mark in favor of concrete sidewalks, which when constructed carefully did not need such repairs and therefore afforded the department more time and money for its growing duties. When the 1896 construction season began and the cement was finally poured in Fort Allen Park, Fernald's title had been changed to Commissioner of Public Works.<sup>482</sup> That shift entailed a clearer managerial unification of streets work—surveying, marking, grading, and paving—with the ongoing work of sewer construction and stormwater management. The pre-existing drainage projects, which included both the burying of cemented pipes and catch basins and the laying of cobblestone gutters, were often nearly so important to walking experiences as the budding pavement projects.

Artificial stone sidewalks began to assume an additional role in Portland during 1896, when all 457 feet of new paths went into the central corridor. That length was split in three roughly equal parts that were built along Congress Street, the parallel Free Street, and a cross street, Oak.<sup>483</sup> Businesses, likely aware of the material's favorable enduring smoothness to bricks, were buying into concrete as the

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<sup>479</sup> *Annual Report of the Commissioner of Public Works, Portland, Maine, 1895-96*, 48.

<sup>480</sup> *Annual Report...1895-96*, 49.

<sup>481</sup> *Annual Report...1895-96*, 50.

<sup>482</sup> *Annual Report of the Commissioner of Public Works, Portland, Maine, 1895-96*, 67.

<sup>483</sup> Office of Commissioner of Public Works, *City of Portland Annual Report of the Commissioner of Public Works, 1896-97* (Portland, ME: William M. Marks, 1897), 66-67, PWD.

sidewalk material of choice. While their lot-by-lot requests by no means created a uniform experience of walking atop concrete for pedestrians following along Congress Street, many customers were not walking the length of Congress anyway. This was the primary artery of the streetcar system, and accordingly the street's sidewalks also served as platforms for that transit option as well as for those traveling by personal or hackney carriage.

The role of concrete sidewalk as luxurious modern platform became clearer in 1897, when the one 160-foot block of Congress Street to receive this treatment was not in the business district.<sup>484</sup> Instead, it was up the eastern escarpment, on the property of a striking new church in the Munjoy Hill neighborhood. The hundreds of residents who attended St. Lawrence Congregational had abandoned their outgrown chapel and built a Queen Anne structure of cut stone and slate-covered gables, with stained glass galore.<sup>485</sup> Inside was a new pipe organ, so large it would not have fit in the old chapel.<sup>486</sup> The artificial stone sidewalks, which rounded the corner onto Beckett Street, were a gift from building committee member Benjamin Thompson in memory of his father.<sup>487</sup> They amounted to an apron of concrete by which attendees arriving in streetcars or carriages could reach the sanctuary with reduced risk of stumbling on uneven ground or muddying a hemline or shoe tip in puddles.

Artificial stone sidewalk construction became increasingly common in the final years of the 1890s (Fig. 3.6). Many of these projects either continued the remaking of sidewalks in the central corridor or brought the novel material into the residential blocks near Fort Allen Park and the Eastern Promenade. Beginning in 1897, there were also hundreds of feet in new concrete walks added through the Washburn

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<sup>484</sup> "Measurement of New Sidewalk for St. Lawrence Church, September 25, 1897," Paving Book 4, 46, PWD.

<sup>485</sup> "St. Lawrence Street Congregational Church 75th Anniversary," 1962, BRL.

<sup>486</sup> The detail about the organ was published in the history webpage of St. Lawrence Arts, the non-profit that preserved part of the church structure and adapted it into a visual and performing arts venue. The organization has since rebranded to The Hill Arts and removed the history from their website. For more on the structure, see Frank A. Beard and Robert L. Bradley, "St. Lawrence Church," Cumberland County, Maine, National Register of Historic Places Inventory/Nomination Form, Maine Historic Preservation Commission, Augusta, October 1, 1979.

<sup>487</sup> "St. Lawrence Street Congregational Church 75th Anniversary," 11.

and Roberts residential cluster during every year for more than a decade. This concentration of concrete sidewalks made the blocks unlike any other part of Portland. What it did, however, was make them more like the inland streetcar suburb of Deering.

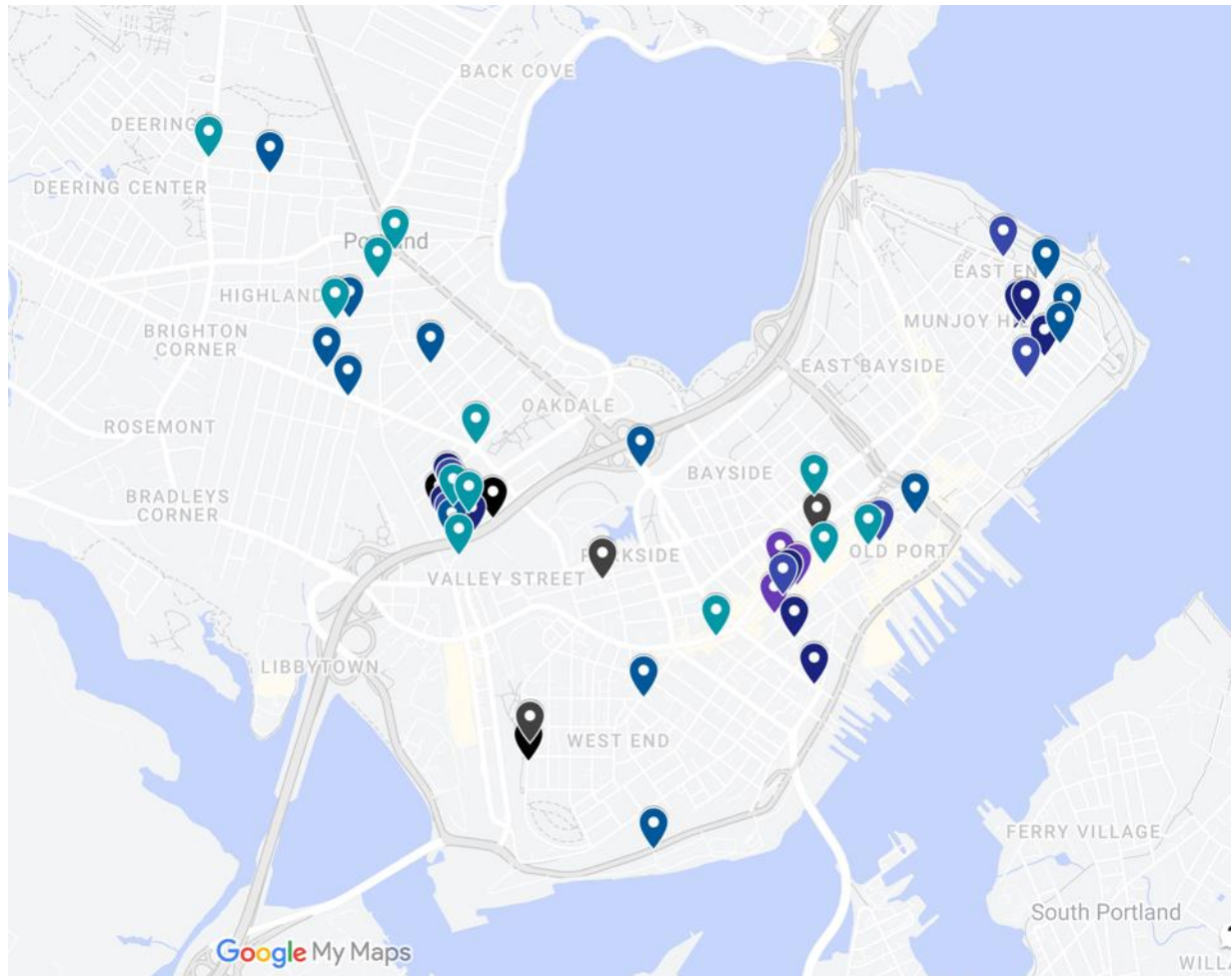


Figure 3.6. Approximate locations of artificial stone sidewalks laid in Portland, Maine, from the first use of concrete for public walks in 1894 through the 1900 construction season. The points, which represent the street rather than the specific location of a project, are graded from lighter over time, starting with black for 1894. Neighborhoods beyond Oakdale were part of the City of Deering until the 1899 annexation. Created by the author atop map data ©2025 Google.

Portland officially annexed Deering in 1899, thereby taking charge of an area in which street development was happening at least as quickly if not faster than on the peninsula. Both Deering and Portland officials were quite conscious of the lagging public works in the former, which had only recently

incorporated as a city itself (Fig. 3.7). The scramble for better drainage and surfacing that Portland's staff inherited with annexation included efforts to lay concrete sidewalks. In 1899, five hundred feet, or one third of the artificial stone sidewalks built in the newly enlarged Portland, were in Deering.<sup>488</sup> In 1900, the department put down two thousand feet of concrete walks along Forest Avenue, the main streetcar and carriage route into Deering, in addition to another four hundred some feet split between Stevens Avenue, another streetcar artery, and residential streets.<sup>489</sup> Those 1900 Deering projects constituted more than two-thirds of the total length Portland laid in concrete walks that year.<sup>490</sup>

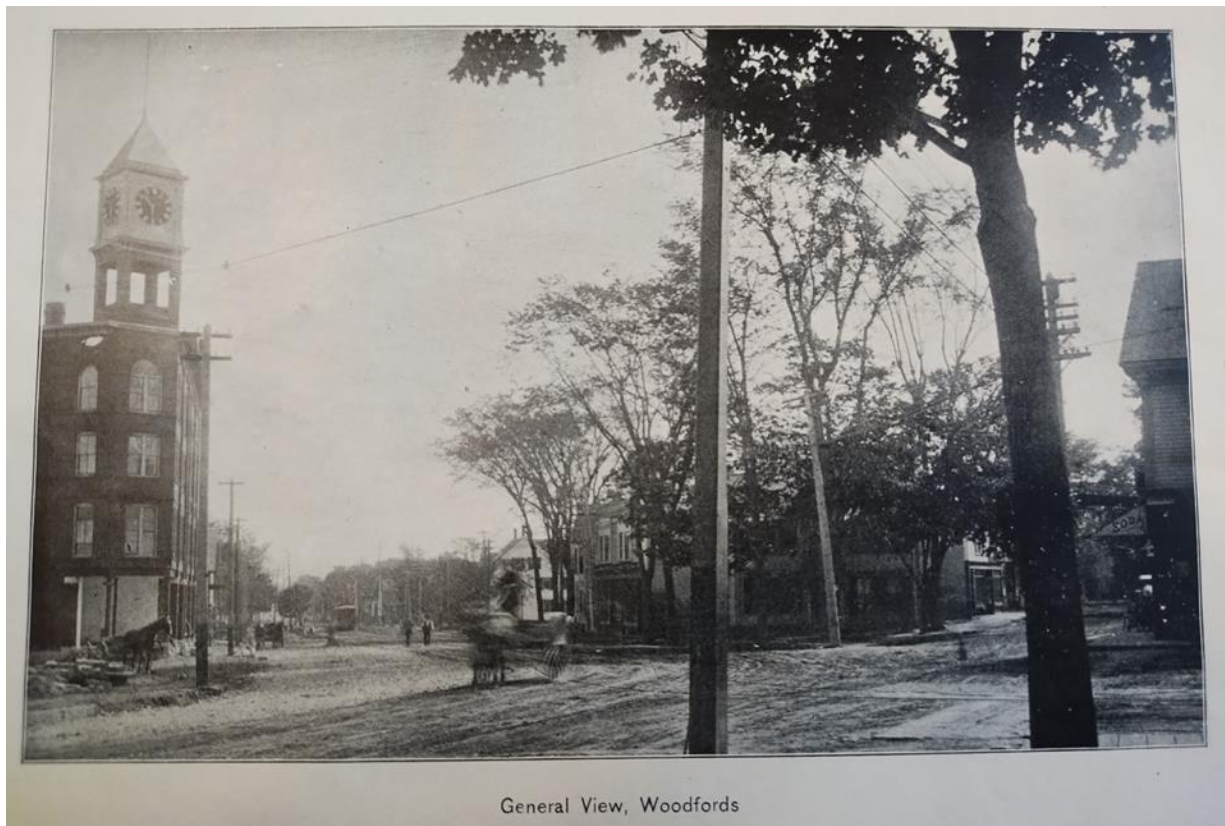


Figure 3.7. Deering's Woodfords Corner intersection, showing dirty road surfaces and inconsistency of sidewalks and crosswalks. On the left is some evidence of the ongoing construction by which Deering

<sup>488</sup> Office of Commissioner of Public Works, *City of Portland Annual Report of the Commissioner of Public Works 1899-1900* (Portland, ME: The Thurston Print, 1900), 24-25, PWD.

<sup>489</sup> For streetcar arteries, see *Remember the Portland Trolleys*, 7-8.

<sup>490</sup> Office of Commissioner of Public Works, *City of Portland, Annual Report of the Commissioner of Public Works 1900-1901* (Portland, ME: Marks Printing House, 1901), 102-103, PWD.

was quickly developing into a modern city landscape. Published in *Deering: A City of Homes* 1897, and viewed at the Brown Research Library of the Maine Historical Society.

Portland was a bigger city with more land, more people, and more lengths of sturdy, smooth sidewalk. Thanks to the annexation as well as to continued immigration, especially of Eastern European Jewish and Italian families into the dense housing near its wharfs, Portland's population reached 50,000 in 1900, after slowly climbing through the 30,000s in the preceding decades.<sup>491</sup> The Department of Public Works was then paving well over a mile of sidewalks each year, and the share of that made with concrete was rising year by year. 1901 marked the first construction season in which artificial stone surpassed bricks, accounting for a slim majority of the nine thousand feet of new sidewalks laid in Portland.<sup>492</sup> Through 1905, new cement sidewalk surface remained more extensive than the new asphalt mixes with which city crews began to pave some roadbeds.<sup>493</sup> Many streetscapes images from the time show roads of gravel, dirt—often churned to mud here and there, or cobblestone—often pockmarked with puddle-filled depressions where the uncemented stones no longer held the grade (See Fig. 3.8). In Portland as elsewhere in the United States, new concepts of sidewalks and new expectations for them quickly

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<sup>491</sup> For the Jewish community adjacent the wharfs, see Benjamin Band, *Portland Jewry: Its Growth and Development* (Portland, ME: Jewish Historical Society, 1955), 14-16. For the Italian population, note especially the names on or near Freeman's Lane (now Adams Street) in *Directory of Portland including the City of South Portland and the Town of Cape Elizabeth* (Portland, ME: Portland Directory Co., 1910). For a synopsis of the neighborhood's history, see Julie Larry and Gabrielle Daniello, "History of Portland's India Street Neighborhood," a report for the City of Portland's Historic Preservation Office, <https://portlandbrick.org/wp-content/uploads/2019/04/India-Street-Portland-Maine-Narrative.pdf>, accessed February 24, 2025. Displeasure with the ethnic diversity of immigration and the density of their housing directly motivated city planning toward open, clean walking environments. See Joseph A. Conforti, "Introduction," in *Creating Portland*, xxi-xxii. Portland's dense and relatively unmodernized immigrant neighborhoods would remain an object of local leaders' derision into the national blight and slum clearance era discussed in chapter five, a process of car-centric and otherwise antisocial demolition that in Portland culminated in 1969 with the widening of Franklin Street into an arterial toward the new Interstate 295 highway.

<sup>492</sup> Office of Commissioner of Public Works, *Annual Report of the Commissioner of Public Works, City of Portland 1905* (Portland, ME: Marks Printing House, 1906), 42, PWD.

<sup>493</sup> *City of Portland, Annual Report of the Commissioner of Public Works, 1910*, 33.

emerged. Previously a convenience largely reserved for business districts and fashioned of flagstone, elegant and lasting sidewalks were now an amenity liberally applied throughout the modern city.



Figure 3.8. This section of State Street in Portland, Maine, 1901, included smoothly paved sidewalks, curbstones, cobblestone gutters, and a dirty roadbed. Image published in *Souvenir of Portland, Maine*, viewed at the Brown Research Library, Maine Historical Society.

As the frequency of quality sidewalks increased, some Portlanders across classes pushed for increasing sidewalk utility by creating connecting paths into and out of the downtown. Yet others pushed back against attempts to make pedestrian networks. Among those averse to paving sidewalks were landowners in a district of warehouses and garages near the intersection of Lancaster and Boyd Streets that had, until recently, been an overlooked space on Portland's backside. In 1900, two of these men objected to a petition from nearby residents that would have the city build sidewalks on their properties and accordingly assess a share of costs to them as abutters. Major Charles Boyd's land was used for rented stables, and he understood paved walks as a slipping risk for horses and therefore an inconvenience to his tenants' daily actions. Samuel H. Colesworthy thought sidewalks unnecessary since there were no buildings on his land. The pavement petitioners occupied homes in newly developed blocks from which they understood the commercial district as walkable but for Boyd and Colesworthy's unimproved and

often mucky properties. Streets Superintendent George S. Staples unequivocally supported the petitioners at a city council meeting, imploring action so “the people who lived in that section of the city would no longer be obliged to wade through mud and filth in getting up town.”<sup>494</sup> Staples’ language matches other petitioners of the era who dramatized the experience of walking without pavement, especially in the precarious urban environments of the Mountain West. But resorting to this rhetoric evidenced a hiccup in Portland’s sidewalk construction at Lancaster and Boyd, one that points to the potential contentiousness in the petitioning process and broader hesitations around the mission for public concrete sidewalks that were particularly obvious in the cases of several Montana towns.

The democracy of allowing either individual property owners to decide sidewalk materials or residents to petition their municipal officials for new walks did not lead uniformly toward concrete. Each year in Helena, Montana, street improvement requests directed to mayors and aldermen began arriving steadily in May, at the beginning of construction season. Helena petitions from 1895 on show increased resistance to city orders for permanent sidewalks. Sensing popular support for greater sidewalk uniformity, city officials passed an ordinance in 1901 calling for concrete sidewalk construction across the length of several blocks in the city’s center. Suddenly, the petition system became an avenue for explicit objections to uniform sidewalks. One objector, Stephen Gilpatrick, did not question the need for smooth and durable sidewalks but rather the specific requirement of cement. Gilpatrick owned a property on which had been recently constructed a traditional stone sidewalk, of “hewn granite slabs” that he had procured and hired laborers to place “at considerable expense.” The city’s order meant the new granite surface was to be, in Gilpatrick’s resentful words, “wholly destroyed and displaced” in favor of a concrete sidewalk. The frustrated property owner pointed out that the existing material was “at least as good, safe, durable and ornamental as the cement walk proposed.”<sup>495</sup>

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<sup>494</sup> “Question of Sidewalks: Spicy Hearing Yesterday Afternoon,” *The Portland (ME) Daily Press*, May 26, 1900, 4, CA.

<sup>495</sup> S.C. Gilpatrick to the Honorable Mayor and City Council of the City of Helena, Montana, August 1, 1901, “Petitions” – 1905-1906, box 3, folder 1, Helena (Mont.) City Clerk Records, 1881-1918, MTLA.

Other Helena property owners thought that orders for concrete sidewalks qualified not only by past construction but also by planned future improvements. In 1906, resident and business owner Robert Hale wrote the mayor and council to dispute a proposed cemented walk. First, he claimed the existing non-cement walks, constructed after a previous city decree, remained in good enough shape that he should not be assessed any cost for replacing it. Second, he noted that there was no structure on this property but that he was planning to erect one. It would be a five-story building that came up against the right-of-way, and excavating for its foundation would surely compromise any existing concrete walk. Hale promised that as soon as the subterranean elements were in place he would consent to the Council's plan for cement sidewalk on that block.<sup>496</sup> Even as they became ubiquitous, the fact that concrete walks made a particular construction sequence logical on each lot needed continuous reconciliation with the fact that bulk projects were more cost-effective for cities and provided more reliable mobility to residents.

To some in other Montana towns, the input afforded by the petition system seemed hectic and unnecessary. Many civic boosters and council members acted more boldly to bring about cemented walks, sure that such structures were elements of their city's future. In 1903, a coalition mobilized to turn the cow-town and railroad hub of Dillon into a modern city. They quickly succeeded according to Dillon's two newspaper editors, Eugene Poindexter and William Simpson. Simpson's publication delightedly proclaiming that Dillon was "rapidly putting on city airs." What constituted city airs was neither an opera house nor a bustling industrial district nor a population in fashionable dress but rather "new cement sidewalks and crossings, the water works and the electric light plant." It was the unmistakably modern municipal infrastructure that showed Dillon had "passed the village stage."<sup>497</sup> The coalition included various powerful individuals and organizations. Leading the charge were the city council members who, as in Helena, could mandate and specify sidewalk construction. The councilmen began by ordering

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<sup>496</sup> R.S. Hale to "Hon. Mayor and Council of the City of Helena," April 21, 1906, "Petitions" (re: streets, sidewalks, sewers, etc.) - 1905-1906, LG 1, box 3, folder 1, Helena (Mont.) City Clerk Records, 1881-1918, MTLA.

<sup>497</sup> *Dillon (MT) Tribune*, September 25, 1903, 4, MTN.

concrete along the main business district on Montana Street.<sup>498</sup> They hired contractor Ben Hager to round up a crew and they then assessed property owners proportionally for Hager's bills.<sup>499</sup>

Promotion in Simpson's *Dillon Tribune* had begun more than a year prior, with a declaration that costly concrete was a good investment when "the average citizen is growing tired of stumbling over knots and spikes [in wooden sidewalks] and will give cement walks a warm welcome."<sup>500</sup> Whether the editors were in touch with local attitudes or were creating those attitudes through their own boosterism, Dillon's citizens did subsequently show widespread support for concrete. When the council ordered a second round of projects in 1904, they were largely in-fill between concrete walks requested by a variety of groups (Figs. 3.9, 3.10). Hager had contracted projects for two fraternal orders, a stretch of homeowners, the county school district, and the Montana State Normal College.

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<sup>498</sup> "City Council Meets," *Dillon (MT) Examiner*, June 10, 1903, 7, MTN.

<sup>499</sup> "Local Department," *Dillon Examiner*, September 2, 1903, 3, MTN.

<sup>500</sup> *Dillon Tribune*, April 18, 1902, 4, MTN.

### August 1903 - September 1904

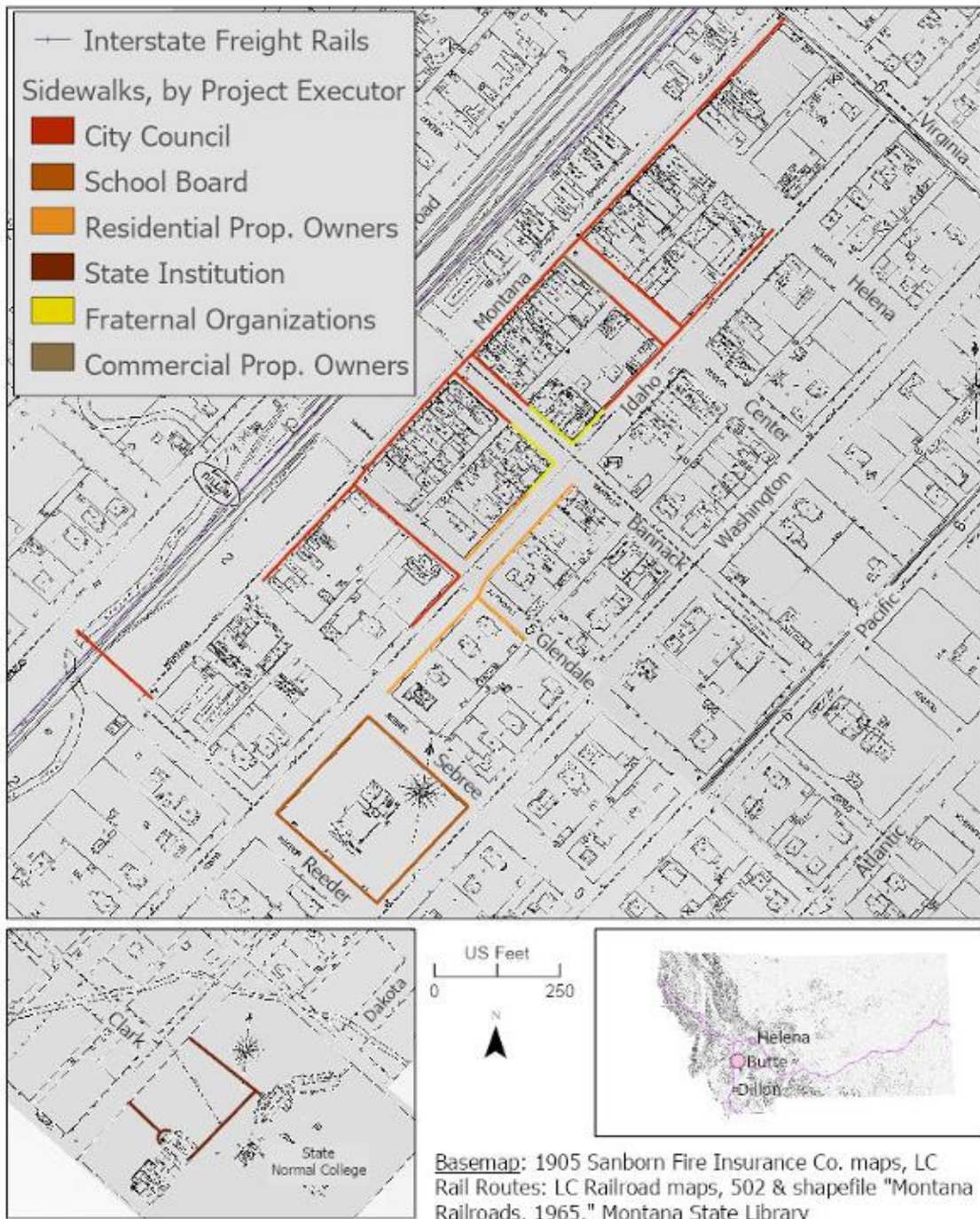


Figure 3.9. A map view of the same projects in Dillon. Created by the author with ESRI ArcGIS.

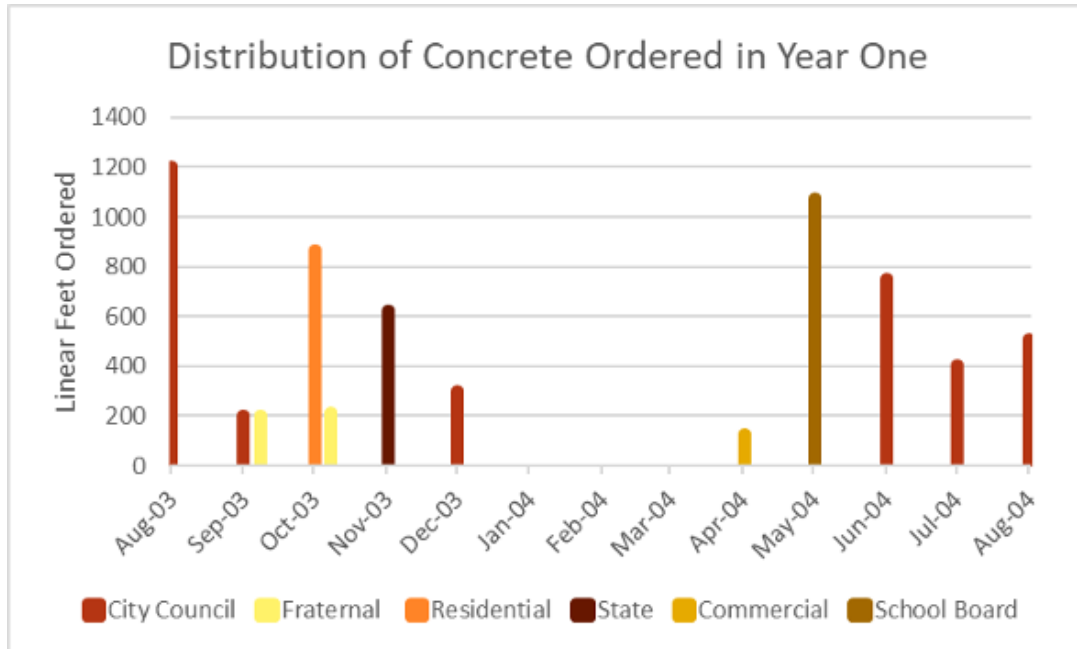


Figure 3.10. Chart showing feet of concrete sidewalk projects in Dillon by month, according to who initiated the sidewalk.

Dillon’s coalescence around concrete sidewalks contrasted remarkably with Livingston, where Hager arranged a contract in 1904. The Livingston council’s first concrete sidewalk development action was sweeping. The city contracted Ben Hager and his crew for eight times the sum that Dillon city council’s budgeted for its first deal.<sup>501</sup> Furthermore, Hager’s contract was not the lowest bid. The financial questions, combined with the number of property owners affected, created a series of legal messes.<sup>502</sup> Among them were a long court battle against Hager and a tangential case against Park County Free High School, which alleged the school had not paid for its concrete sidewalks and which ended up before the Montana Supreme Court.<sup>503</sup> That same year, aldermen in Billings temporarily rescinded a concrete sidewalk order after aggrieved property owners showed up to a meeting in protest.<sup>504</sup> The

<sup>501</sup> “Ben Hager Gets a Big Contract,” *Dillon Examiner*, August 10, 1904, 1, MTN.

<sup>502</sup> “Hager’s Trouble Not Ended,” *Dillon Tribune*, September 2, 1904, 5, MTN.

<sup>503</sup> “Court Papers - H.L. Wilson, T.R. Hinds, and A.B. Cook vs. Yegan Brothers and Cothron and Todd (re Park County Free Public High School sidewalks),” December 7, 1907, MC 280, box 56, folder 1, A. B. Cook Papers, 1882-1940, MTLA.

<sup>504</sup> “Revokes Its First Order,” *Billings Gazette*, June 10, 1904, 1, CA.

inherent impositions of concrete sidewalk construction, and the possible backlash, were known to the editors of Libby, Montana's *Herald* when, in 1910, they announced that city's plans to build "cement sidewalks throughout the greater part of the town" with the qualification "unless there should be an unlooked for and overwhelming protest."<sup>505</sup>

Helena's resistance to cement walks now seemed tame by comparison. With perhaps a reasonable exception here and there for a walk that was already solid stone, concrete sidewalks did become uniform through the city's center just as they did, one way or another, along main streets in most Montana cities. In other neighborhoods, however, the lot-by-lot process for sidewalks and their materials continued. As a result, concrete sidewalks in much of Helena remained patchy amidst an array of non-concrete paths. In 1911, persistence of this heterogeneity led Peter Miller, the frustrated owner of a business just outside downtown, to write the city's leaders. From his front door he could see "wooden sidewalks, cement sidewalks, asphalt sidewalks and open spaces with no kind of a sidewalk." Instead, he thought it "desirable to have uniform sidewalks" along the street and he petitioned for a special improvement district to that end.<sup>506</sup> Through this combination of individual requests and municipal actions, concrete sidewalks spread, albeit sometimes haltingly, through cities big and small.

Records from Portland, Maine, afford a summary of this grand era in sidewalk construction and the coinciding ascendance of concrete paths. From 1895 to 1908, the City's streets division added twenty-four miles of paved sidewalks—a figure that does not include projects on private land nor, necessarily, all projects on public property that were outside street rights-of-way. Of those twenty-four miles, a little over nine were concrete and a little less than fifteen were brick. Annual construction of cement sidewalks grew from 219 feet the first year to over 3,600 feet in 1903, rivaling the yearly totals for the new brick walks

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<sup>505</sup> "Four and a Half Miles Cement Walks," *Libby (MT) Herald*, May 19, 1910, CA.

<sup>506</sup> Peter Miller, President Helena Floral Co. to Honorable Mayor and City Council, Helena, Montana, October 10, 1911, "Petitions" – 1911-1912, LG 1, box 3, folder 15, Helena (Mont.) City Clerk Records, 1881-1918, MTLA.

that had been Portland's default in previous decades.<sup>507</sup> In 1905, when total sidewalk construction first eclipsed two miles, artificial stone firmly overtook brick as the predominant material for sidewalk construction. New concrete walks continued to be relatively concentrated in the central business district, up-and-coming Deering, and the neighborhoods adjacent to the three major parks. The importance of reliable walking surfaces to the public service these parks were intended to provide was reinforced that year by the Olmsted Brothers landscape architecture firm, which the city contracted for a new and integrated vision of its greenspaces. In these plans, the straight sidewalks of city streets lined up neatly with the beginnings of park paths that invited leisure both by their meandering courses and by their cemented control of the surface environment (Fig. 3.11).<sup>508</sup>

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<sup>507</sup> *Annual Report of the Commissioner of Public Works - City of Portland 1905*, 42.

<sup>508</sup> Bradbury, "Deering's Oaks 1895" Map; "Plan of Western Promenade parks and gardens," undated, Map FOS 204, BRL; Olmsted Brothers Landscape Architects, "City of Portland, ME: General Plan for Eastern Promenade," Brookline, MA, May 1905, BRL.



Figure 3.11. Detail of the 1905 Olmsted Brothers plan for Eastern Promenade and Fort Allen Park, showing the several pedestrian entrances and their connection to city sidewalks. Maine Historical Society collections.

The first wave of concrete sidewalk construction in Portland continued into 1923. From 1909 through that year, more than seventy percent of the City's twenty-one new miles of sidewalk were concrete. This figurative wave crested in 1915, when the City laid nearly two miles of concrete walks alone. In 1917, the pace of total sidewalk construction slowed to below one mile per year for the first time in decades. In 1923, when it picked up again, brick use was resurgent, equaling concrete walks in length

for the first time since 1905.<sup>509</sup> Possibly, concrete's novelty had faded with its ubiquity, which in turn made brick walks a distinguishing feature that many Portlanders embraced. This, at least, was how the City Council would treat the materials several decades later, in the 1970s, when they began securing federal funding to redo the Congress Street business corridor sidewalks in brick.<sup>510</sup> The Council subsequently policy which, with some exceptions for strips of wheelchair-friendlier concrete, would lead to nearly all sidewalks on the peninsula being rebuilt with bricks beginning in the 1980s.<sup>511</sup> But in the early twentieth century, many Portland sidewalks shared the characteristics of concrete surfaces that people encountered in cities across the United States.

#### Characteristics of Concrete Sidewalks

From 1890 to 1910, cities across the country built thousands of miles of new sidewalks. Though some stone and brick paving persisted, and some cities soon found better recipes for asphalt pavements, concrete quickly became the default sidewalk material in the United States. Concrete sidewalks were no different from other cemented spaces of the time, in that their ubiquity made them participants in widespread and enduring cultures of twentieth-century American life.<sup>512</sup> Cement sidewalks performed remarkably well as smooth flat planes atop the earth, speeding up that act of walking by making it less subject to dirty, muddy, slippery, and uneven ground. With help from new sewers and other cement-heavy drainage projects that cities had undertaken, flat-topped cement sidewalks were also relatively puddle-

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<sup>509</sup> Figures for 1894 in *City of Portland 1897-98 Annual Report of the Commissioner of Public Works*, 40; Figures for 1895-1908 in Office of the Commissioner of Public Works, *City of Portland Annual Report of the Commissioner of Public Works 1909* (Portland, ME: Marks Printing House, 1910), 41, PWD; Figures for 1909-1922 in *City of Portland, Maine, Annual Report of the Commissioner of Public Works 1923* (Portland, ME: Marks Printing House, 1924), 28, PWD.

<sup>510</sup> For a report on the 500,000 bricks laid by Richard Donatelli and crew, see *Portland Evening Press*, August 13, 1974, 1, 12, PR.

<sup>511</sup> For reports on the \$29 million renovation of Congress Square and the brick sidewalks, see *Portland Evening Press*, May 20, 1982, 8, PR; *Portland Evening Press*, August 3, 1982, 1, 10, PR.

<sup>512</sup> Portland Cement Association, "Editor's Reference Book on Cement & Concrete, 1927 Edition," 7, CHM.

free. In addition to how well they shed precipitation from above and kept dirt sealed off below, the surfaces were sweepable and washable when they did accumulate unwanted matter.

In the case of sidewalks, “artificial stone” as a synonym for concrete fit well because concrete could so well replicate the smoothness and solidness of earlier flagstone pavers.<sup>513</sup> Those structures, typically slate or sandstone slabs but occasionally granite as seen in Montana, had a long history as demonstrated in Boston. Flagstones had more recently also been the exclusive sidewalk material of New York City.<sup>514</sup> The similarities between flagstone and concrete are key to understanding how these sidewalks changed the urban environment and what opportunities and realities these structures effected for people in those settings.

The new artificial stone walks extended what might be termed “polite pedestrian surfaces” out of the most established commercial centers and into the newest urbanized spaces. Moreover, cement paths effectively extended the floorboards of ballrooms and parlors into a curated out-of-doors. Concrete, being eminently sweepable and even washable and not so sticky as asphalt mixes of the day, made surfaces recognizably more sanitary. Historian Gabriel Lee illustrates the involvement of cemented surfaces in various pushes for standardizing environments during the nation’s Progressive Era, during which concrete came to define what sanitation meant when it came to construction materials.<sup>515</sup> Through these properties, the early concrete sidewalks immediately began reshaping urban cultures, especially in the residential neighborhoods, commercial districts, and public parks where, as seen in Portland, the new sidewalks were often found. This type of pavement, in theory, made a new type of space for everyone, but in reality, the new clean and reliable experience disproportionately benefitted affluent women, who could now move

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<sup>513</sup> These sidewalks were alternately referred to as “artificial stone” and “cement” in many early references, including all instances found in City of Portland reports. See *Annual Report of the City Civil Engineer, Portland, Maine, 1894-95*, 24. For a thorough investigation of nineteenth-century stone pavers in New England, with case studies of Boston, Cambridge, Nantucket, and New Bedford, see Rayport Hedges, Sullivan, and Pfeiffer, “Historic Paving and Sidewalks in New England.”

<sup>514</sup> Regarding New York City’s use of flagstones, see footnote 168 in Lee, “Concrete Dreams,” 106.

<sup>515</sup> Lee, “Concrete Dreams,” 96-97.

about in the fresh air with minimized fear of dirtying boots, petticoats, and hems.<sup>516</sup> These elements of gender and class were certainly at play among cement sidewalks laid in the 1890s through Portland, Maine's Western Promenade and the surrounding upscale neighborhood.<sup>517</sup>

Cement became the standard bearer among all sidewalk materials.<sup>518</sup> This happened not only because concrete's plasticity allowed for durable, smooth surfaces that replicated flagstone but also because these surfaces endured. This endurance contrasted with bricks, which even if initially smooth and clean tended to deform within a matter of years. With exposure and use, bricks would sink to form water-holding depressions, their corners would protrude from the ground, or a lower quality brick here and there would simply disintegrate and mix into a filthy composite trapped within a rectangular pockmark. At the turn of the century, the Portland Department of Public Works re-laid or replaced miles of relatively new brick sidewalks annually.<sup>519</sup> By contrast, contractors promised that their new concrete sidewalks would last decades. Indeed, nearly no concrete sidewalks in Portland needed redoing as of 1920.<sup>520</sup> Early evidence of longevity helped justify the expense and occasional difficulty of obtaining cement, though cement's availability increased and prices fell with drastically increased domestic production between 1890 and 1910.<sup>521</sup>

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<sup>516</sup> This was a real worry for some society women in the late nineteenth-century United States. See Kirke Elsass, "Cement's Role in Modernizing Montana, 1867–1960," *Montana: The Magazine of Western History* 72, no. 1 (Spring 2022): 25.

<sup>517</sup> "Street Notes: Great Demand for New Sidewalks This Year," *Portland Daily Press*, July 18, 1895, 8, CA. See also, "Maine General Hospital, Portland, ca. 1915," postcard, Maine Medical Center collection, Maine Historical Society, [mainememory.net/record/7387](http://mainememory.net/record/7387), accessed February 24, 2025.

<sup>518</sup> For how standardized concrete sidewalks were by the early years of the twentieth century and how this set the standard for sidewalk construction generally, see Beery, *Portland Cement Side-walk Construction: Based Upon the Experience of Many Successful Contractors*.

<sup>519</sup> Office of the Commissioner of Public Works, *City of Portland Annual Report of the Commissioner of Public Works 1906* (Portland, ME: Marks Printing House, 1907), 40, PWD.

<sup>520</sup> Office of the Commissioner of Public Works, *City of Portland Annual Report of the Commissioner of Public Works 1920* (Portland, ME: Marks Printing House, 1921), 20, PWD.

<sup>521</sup> On the order of magnitude increase in American cement production between 1890 and 1910, see Eckel and Burchard, *Portland Cement Materials and Industry in the United States*, 32. For details of the rapid drop in cement prices from 1890 to 1900, see Lee, "Concrete Dreams," 71-72.

Concrete sidewalks were part and parcel of the public infrastructure improvement regime that many urban and environmental historians have documented insofar as it concerned sewers and roads.<sup>522</sup> Christopher Wells' account of American automobile cultures as an integrated development of landscapes and social institutions is perhaps the most helpful for understanding the ecology of modern urban walking. Wells chronicles the process by which, as he puts it, roads became not organic elements of the Earth's surface that reflected local conditions and values, but instead a standardized, professionally constructed technology largely disconnected from regional environments.<sup>523</sup> As was the case with the macadam and asphalt roads that co-created a recognizable culture of automobility across the United States, the uniform engineering and relatively uniform experience of cement sidewalks had consequences for society.

#### New Definitions of Walkability

In recent decades, American urban planners and big data start-ups have created various metrics for a neighborhood's walkability.<sup>524</sup> Distance is a primary criterion or, in some cases, the only criterion for whether a transit route is walkable. Half a mile from home to work? Almost certainly walkable. Two miles from home to the grocery? Probably not. This might be termed distance walkability, a measurement best understood in contrast to the spatial sprawl of automobile-dependent development. Other popular

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<sup>522</sup> Martin V. Melosi, *Garbage in the Cities: Refuse, Reform, and the Environment, 1880-1980* (College Station: Texas A&M University Press, 1981); Gabriel Dupuy and Joel Arthur Tarr (eds.), *Technology and the Rise of the Networked City in Europe and America* (Philadelphia: Temple University Press, 1988); Martin V. Melosi, *The Sanitary City: Environmental Services in Urban America from Colonial Times to the Present* (Pittsburgh: Univ of Pittsburgh Press, 2000); Theodore Steinberg, *Down to Earth: Nature's Role in American History* (Oxford University Press, 2002).

<sup>523</sup> Christopher W. Wells, *Car Country: An Environmental History* (Seattle: University of Washington Press, 2012), 33.

<sup>524</sup> Such definitions of walkability are central in Jeff Speck, *Walkable City: How Downtown Can Save America, One Step at a Time* (New York: Farrar, Straus and Giroux, 2012). See also explanations of the Walk Score website for quantifying walkability at any address in the United States: "About Walk Score," [walkscore.com/about.shtml](https://walkscore.com/about.shtml) and "Walk Score Methodology," [walkscore.com/methodology.shtml](https://walkscore.com/methodology.shtml) – each accessed January 9, 2025.

metrics of walkability are explicit about their oppositional relationship to car-friendly infrastructure by scoring a route as more walkable if they are kept safely and pleasantly separated from auto traffic.<sup>525</sup> This recent concept of what is walkable presumes easily traversed ground surfaces. In a time when such surfaces were not taken for granted even in many populated areas, concrete sidewalks highlighted and further defined a very different definition of walkability.

As concrete walk construction picked up, Americans from cities on the Eastern seaboard to small towns in the Rocky Mountains were frustrated with ground they deemed unwalkable. The 1746 petitioners on Boston's Milk Street are evidence that outcry over substandard surfaces was not entirely new. But only after the concrete sidewalk paving regime picked up did city pedestrians from Maine to Montana start to regularly define blocks as "impassable" to pedestrians due to the sidewalk infrastructure those blocks lacked.<sup>526</sup> Occasionally this language showed up in letters to the editor or local news reports printed on the same page as advertisements for rubber boots and overshoes.<sup>527</sup> In Helena, Montana, "impassable" began appearing in petitions that decried blocks that pedestrian throughgoing traffic apparently avoided and where the street's residents found their homes only "uncomfortably accessible."<sup>528</sup>

Once concrete sidewalks had become well established, this frustration with streets that were "impassable" to pedestrians became more pointed. And some observed the social inequities of where sturdy sidewalks were versus where they were not. In 1917, a resident of Bridgeport, Connecticut identified as A.W. LeBreuf took up the case for improving a working-class neighborhood known as Remington City, adjacent the eponymous firearm manufacturer's plant. The neighborhood's residents had

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<sup>525</sup> Arlie Adkins, Carrie Makarewicz, Michele Scanze, Maia Ingram, and Gretchen Luhr, "Contextualizing Walkability: Do Relationships Between Built Environments and Walking Vary by Socioeconomic Context?," *Journal of the American Planning Association* 83, no. 3 (2017), 296-314.

<sup>526</sup> Even in the previously mentioned 1871 instance of impassable being used to describe a road section in Augusta, Maine, this term was used in contrast to ongoing construction of paved sidewalks elsewhere in the city.

<sup>527</sup> For example, "Local News," *Connecticut Western News* (Salisbury, Litchfield Co., CT), April 20, 1899, 3, CA.

<sup>528</sup> Resident Taxpayers Residing in Hoback and Cannon's Addition to the Honorable, the City Council of the City of Helena, Montana, "Petitions" – 1887.

“for over a year been obliged to wade through muddy streets (there is nothing that resembles a sidewalk) almost continually in order to go to and from their work and to the downtown districts.” The streets became mud pits in “the least thaw or rain.” LeBreuf contrasted what these workers experienced with the many Bridgeport streets where sufficient sidewalks typically allowed people to at least access a streetcar if not walk all the way from home to work without getting all “mucked up.” This was a matter of fairness to fellow citizens who paid taxes like everyone else and, as recent immigrants like LeBreuf perhaps once was himself, were taken advantage of by Remington City landlords and merchants.<sup>529</sup> He suggested the city could at least give the neighborhood plank or cinder walks, features that would have been regarded as decent two decades before but were now a significant compromise compared to concrete.

As unpaved urban areas like Remington City became the exception, cement emerged as a keystone material in an ecological system of walkability that became the expectation in cities. This ecology continued to be dynamic even after the emplacement of solid and enduring concrete walks. The nature of pedestrianism in urban space, whether a mile-long walk or a few steps from car door to convenience store, has always been and always will be about more than an individual simply perambulating in the abstracted manner of a stick-figure crosswalk light. Pedestrianism requires considering the foot covering that people did or did not wear outside, the ground surfaces on which they stepped, the elements of weather, and the structures and behaviors that maintained or regulated walking spaces.

#### Concrete Sidewalks Cultures, Part I: Cement Citizenship

Mikael Hård and Andrew Jamison, in their multifaceted historical study of how people culturally appropriate technologies, state that “to be effective, urban infrastructures require that citizens adjust their

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<sup>529</sup> “Remington City Streets Muddy as Forest Path: Man Who Has Team of Horses Busy Hauling Stalled Vehicles,” *The Bridgeport (CT) Evening Farmer*, March 1, 1917, 4, CA.

behavior and patterns of life to the demands of the system.”<sup>530</sup> That is, rather than simply reflecting pre-existing sociocultural phenomena, infrastructures like sidewalks help create new phenomena within society in the name of functionality. This occurred in the case of the concrete sidewalks that spread an experience of comfortable walking throughout American cities. Simultaneously, those structures stretched the expectations for sidewalk maintenance, animating new civic conversations around sidewalks.

In the 1890s, as Portland’s streets division invested more heavily in new cement sidewalks and in redoing uneven brick sidewalks to keep up with the new expectations for walking surface qualities, the city’s mayor and council set about to adjust and enforce sidewalk-related behaviors. They did so with a flurry of new ordinances and amendments, which themselves were sometimes amended within a few years. The new standard for sidewalk surfaces that cement generated was important context for new amendments that focused on facilitating easy and quick pedestrian movement.

Before 1890, the few amendments pertaining to Portland city streets were meant to avoid obvious safety threats rather than maximize an ideal potential for sidewalk space. In 1883, Portland’s council greatly restricted handling or storing large quantities of combustible petroleum products “upon any alley, sidewalk, street or wharf.” In 1886, they slightly altered an ordinance that effectively banned the playing of ball sports in public rights-of-way and outlawed the throwing of stones or snowballs. In 1890, they amended an ordinance to ban other projectiles including bows and arrows, air guns, or sling shots in the same spaces.<sup>531</sup> But amid their sidewalk investment in the 1890s through increased budget allocations and approval of special assessment structures, municipal leaders made broader moves to protect the sidewalk environment from behavior that would compromise the free movement of pedestrians in any way.

Some of the typical municipal laws that Portland adopted pertained to setting up anything that would remain in the way of pedestrians for longer times. These ordinances were the most basic of legal

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<sup>530</sup> Hård and Jamison, *Hubris and Hybrids*, 223.

<sup>531</sup> For petroleum storage, see *The Ordinances of the City of Portland Passed Since the Edition of 1882* (Portland, Me.: William M. Marks, 1896), 20, BRL. For sports and throwing objects, see the same, 36. For shooting projectiles, the same, 50.

complements to the modern paved sidewalk, countering those who would position objects or themselves on what was intended to be a smooth, unobstructed path. Some laws banned use of sidewalks for the signs, goods, and the stands of vendors or shop owners who recognized that clean concrete walks' virtual extension of indoor space was an opportunity for business. While that set of laws against potential obstructions to foot traffic were relatively straightforward, an 1892 provision against loitering and similar laws that followed were obviously more problematic.<sup>532</sup> In 1897, a Robert Timmons was outed in the local press for having been fined \$5 after "obstructing the sidewalk" at the corner of Preble and Congress. The officer who cited him claimed eight or nine others regularly loitered at that intersection, but they seem to have gone unpunished while Timmons got the fine for being "impudent" to the officer.<sup>533</sup>

The following year, Portland's council legislated sidewalk activity further. The body passed ordinances against spitting in street cars, public buildings and on public streets, under a penalty of \$10, notably treating outdoor surfaces as equal to those indoors. One alderman then read a new proposal that would allow authorities to impose increased fines for "sauntering or loitering on a street corner or sidewalk five minutes after being ordered by the mayor or any officer in authority to move on." Another alderman spoke up to suggest existing ordinances might be sufficient, and a third saw significant potential for the proposed to "be misapplied if a person had any grudge against another," adding that Portland's sidewalks were never so crowded as to justify such a measure. The matter was referred to committee for further deliberation on whether Portland had done enough to realize the potential of its sidewalks.<sup>534</sup>

### Illegal Bicycling

Bicycle enthusiasts, a burgeoning group across the country in the 1890s, were another subject of new ordinances regarding street use, in Portland as in other cities. These regulations did not all pertain to keeping sidewalks clear for pedestrians. For example, an 1893 Portland law simply added bicycles and

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<sup>532</sup> *The Ordinances of the City of Portland...since 1882*, 68.

<sup>533</sup> "Municipal Court," *The Portland Daily Press*, September 28, 1897, 5, CA.

<sup>534</sup> "Council the Seat of War," *The Portland Daily Press*, December 6, 1898, 5, CA.

tricycles to animal-drawn carriages as subjects of the citywide speed limit, six miles per hour.<sup>535</sup> But increasingly, regulating bicyclists meant keeping them off the smooth new sidewalks to which they were drawn.

In September of 1893, the press reported that sidewalk bicycle riding was “again getting to be a nuisance” at Portland’s border with Deering, still a distinct municipality. Unlike in Deering, bicycling on sidewalks was illegal in Portland due to purported disregard for pedestrians, but police officers struggled with enforcement. For instance, some riders would dismount when warned by an officer but, after walking there bike a short distance, would hop back on and take to the sidewalk again. Provided the officer did not know them, the scofflaw rider was free.<sup>536</sup> In 1894, after a girl was reportedly hit by a wayward bicyclist, police adopted a new approach that amounted to conducting stings at Portland’s city limits.<sup>537</sup> In one day’s operation, officers rounded up thirty riders. Many more offending riders were involved, but they evaded officers or simply sped up and biked away when told to stop and face the law.

The cycling situation points to the fact that on many blocks, sidewalks were improved to a degree of smoothness and solidity that roadbeds did not even approximate (Fig. 3.12). *The Portland Daily Press*, in covering the stings, editorialized against road repair practices that left loose and sharp broken rock in patches of the road that bicyclists were right to avoid. This disparity between road and sidewalk existed even while bricks remained the nearly exclusive sidewalk material. Even after 1900, many Portland roadbeds were only dirt or paved in cobblestones, too uneven for a comfortable ride even on those bicycles equipped with the new technology of pneumatic rubber tires.<sup>538</sup> Concrete sidewalks exacerbated

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<sup>535</sup> *The Ordinances of the City of Portland...since 1882*, 75.

<sup>536</sup> “Deering,” *The Portland Daily Press*, September 21, 1893, 5, CA.

<sup>537</sup> “The Wasps Escape: The Deering Sidewalk Bicycle Riding Situation,” *Portland Daily Press*, June 12, 1894, 5, CA.

<sup>538</sup> Pneumatic rubber tires were commercialized in late 1880s in Great Britain with canvas lining before Michelin developed replaceable inner tubes in 1891. By 1892 similar patents were issued to US manufacturers — see “List of Patents,” *Morning Journal and Courier* (New Haven, CT), January 28, 1892, 4, CA. For circa 1890 develops and how important the rubber tire was to popularization, see David V. Herlihy, *Bicycle, The History* (Yale University Press, 2004), 252.

the discrepancy, further enticed misuse by bicyclists, and compelled Portlanders to advocate for more competent pavement of roads. Many scholars have documented that bicycle enthusiasts helped “awaken a national interest in good roads,” as geographer Gary Tobin put it. Some amount of bicyclists’ push for street improvements prior to widespread automobile use, it turns out, was mediated by fears that bicyclists would overrun the new sidewalk structures intended.<sup>539</sup>

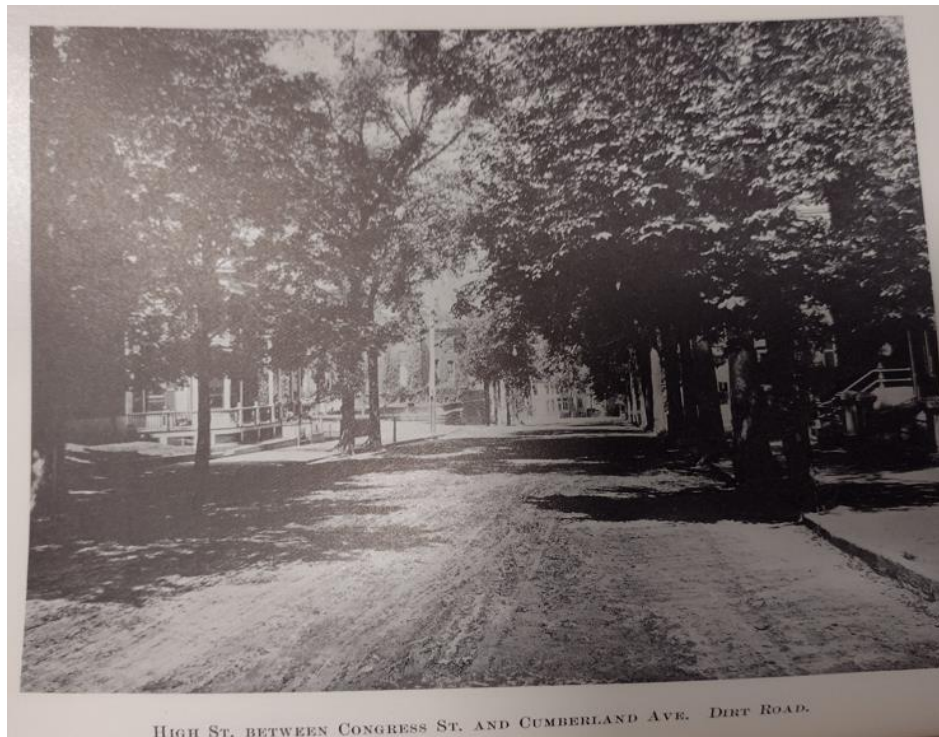


Figure 3.12. The improved sidewalks on this block of Portland’s High Street would have appealed to cyclists over the dirt roadbed, especially in inclement weather. From the 1903 *Annual Report of the Commissioner of Public Works*.

However, in the early years of concrete sidewalk construction, before widespread asphalt and concrete pavements on roadbeds, cities relied on law enforcement to ensure pedestrian safety and comfort. In 1895, Portland introduced a more targeted ordinance for bicycles. This version separated

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<sup>539</sup> Gary Allan Tobin, “The Bicycle Boom of the 1890s: The Development of Private Transportation and the Birth of the Modern Tourist,” *Journal of Popular Culture* 7, no. 4 (Spring 1974): 838-849; Wells, *Car Country*, 25-8.

bicycles and similar “vehicle[s] of propulsion” from carriages and banned them from “any footpath or turf in any of the public parks, promenades or other public grounds.” It also required that riders carry “a suitable alarm bell, which shall be reasonably sounded” to warn pedestrians of their approach and prohibited riding “in a reckless or dangerous manner,” while revising the speed limit up to eight miles per hour.<sup>540</sup> The same year, Helena, Montana, resident John Smith wrote to his mayor and council about the bicyclists taking over sidewalks. He demanded that they “remedy the evil” by which a “weary plodder” was “no longer safe on the sidewalks.” Smith wrote that Helena was the only city in the country with such a state of affairs. This was clearly incorrect if he meant bicyclists taking to sidewalks but possibly closer to the truth if he meant specifically the City’s lack of ordinances against the same.<sup>541</sup>

Problems with bicycle riding on sidewalks only worsened as the City of Portland added more cement walks and relaid brick walks to better meet the rising smoothness standard. In 1896, the son of neighboring Deering’s streets commissioner was among those arrested for sidewalk cycling. His appeal rested on two points. First, he claimed to have been in an established bicycle lane rather than a true sidewalk. Second, he pointed to the fact that road belonged to the county, which therefore should not have been subject to city laws.<sup>542</sup> That type of jurisdictional dispute likely led the state legislature toward its action, taken in the spring of 1897, to clarify what constituted a *sidewalk* and otherwise bolster laws against bicycling upon them.<sup>543</sup> Portland’s council took the opportunity to promote their new, derivative and sidewalk-defining ordinance through the local press. It read that “All portions of streets constructed in such a manner as to be adapted to the use of pedestrians, and not to the use of horses and carriages” were off limits to bicycle riding. The city marshal was to “rigidly enforce” the newest bicycle regulation.<sup>544</sup>

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<sup>540</sup> *The Ordinances of the City of Portland...since 1882*, 83.

<sup>541</sup> John Smith to the Hon Mayor and City Council, June 25, 1895, Helena (Mont.) City Clerk Records, 1881-1918, MTLA.

<sup>542</sup> “What Is a Sidewalk: That Is a Question Wheelmen Would Like Answered,” *Portland Daily Press*, August 8, 1896, 5, CA.

<sup>543</sup> “Law for Cyclists,” *Portland Daily Press*, March 24, 1897, 3, CA.

<sup>544</sup> “Bicycling Ordinance to Be Enforced,” *Portland Daily Press*, April 27, 1897, 8, CA.

The statewide action empowered greater enforcement beyond Portland. Farther north in Bangor, Maine, the state's directives led to the citation of six cyclists and confiscation of their vehicles in what local accounts called a "raid."<sup>545</sup> Yet bicyclists continued to be elusive for police who primarily operated on foot. And at least occasionally, city officials had to make exceptions. Such was the case in Yarmouth, Maine, in 1898, when during a major street construction project bicyclists were granted sidewalk on one side of street while pedestrians remained entitled to the other.<sup>546</sup> Of course, no amount of planning or police stings could keep every cyclist off every sidewalk. In Portland, despite all its ordinances to protect sidewalks, frustrations with bicycle encroachment continued through the turn of the century.<sup>547</sup> Just the same, municipal officials went on attempting to secure their ideal sidewalk environments.

#### Doing Your Part by Shoveling

Though cement sidewalks established stable horizontal planes on the ground, they could not regulate the other dimensions of pedestrian space. One issue was things coming onto sidewalks from the side, whether bicycles out of the street or retail goods out of abutting shops. Another was things coming out of the sky above. The issue of precipitation generated another set of civic questions about realizing the space's walkability potential. In winter, surfaces in Portland inevitably accumulated layers of snow and ice. Management of frozen precipitation was perhaps the trickiest aspect of concrete sidewalks, which in this arena created a new realm of quotidian labor for city residents in colder climates.<sup>548</sup>

In theory, well-made cement sidewalks created the possibility of a clear path despite winter weather. True enough, scraping nearly all the snow from a cement sidewalk was imaginable unlike doing the same on a gravel path or even a more uneven brick surface. Yet, rather suddenly, these sidewalks

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<sup>545</sup> "Bangor Sidewalk Riders Arrested," *Portland Daily Press*, May 18, 1897, 6, CA.

<sup>546</sup> "Yarmouth," *Portland Daily Press*, September 3, 1898, 3, CA.

<sup>547</sup> "Riding on Sidewalks," Letters to the Editor, *Portland Daily Press*, May 24, 1900, 4, CA.

<sup>548</sup> For more on the theme of modern technologies creating new household work, and to understand sidewalk shoveling as an exception to typical gendering of the same, see Ruth Schwartz Cowan, *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave* (New York: Basic Books, 1983).

extended for miles even within smaller cities, creating the need for a comprehensive shoveling effort. Furthermore, as already seen in the 1859 case with flagstones in Boston, impermeable sidewalks created winter issues of their own. Solidly paved walks, especially if inadequately angled towards the street or when bounded by piled snow, became a reservoir for rain or meltwater that could subsequently freeze.

This generated a new set of concerns about slips and falls that began mounting even before ubiquitous cement walks exacerbated them. In January of 1886, a newspaper writer in Bath, Maine, rhetorically asked readers, “What commends a street commissioner to the public more than a plentiful supply of gravel on sidewalks where skates could be better utilized than rubbers?”<sup>549</sup> That December, a note in the *Portland Daily Press* read: “the drizzling rain yesterday froze on the sidewalks and made walking dangerous.” As a case in point, a few columns over was the news that a Mr. Horace Anderson had “slipped on icy sidewalk on Exchange St, and fell striking his head against a step, cutting it quite badly.”<sup>550</sup> This a mere month after the Reverend D. W. Le Lacheur had suffered a broken leg in a similar incident.<sup>551</sup> These cases from the late 1880s show that even as Portland and other cities committed to concrete for further sidewalk construction, many understood that the function of even the sturdiest sidewalks was contingent on broader environmental factors. Nonetheless, concrete only increased the desire to maintain clear walkways regardless of winter weather.

In cities like Portland, snow removal from paved sidewalks had been a public endeavor when their extent was limited to a commercial corridor or two in the city’s center. In 1873, the annual financial report by Portland’s streets commissioner included line items for “shoveling snow, breaking roads, cutting ice from gutters, sidewalks, &c., and carting snow and ice” as well as “sanding sidewalks.”<sup>552</sup> The shoveling of heavily trafficked sidewalks in the main business district contrasted with the general approach of adapting to snow accumulation. For instance, horsedrawn carriages were swapped out for

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<sup>549</sup> “Nothing,” *Bath (ME) Independent*, January 30, 1886, 3, CA.

<sup>550</sup> “Brief Jottings,” *Portland Daily Press*, December 14, 1886, 4, CA.

<sup>551</sup> “Brief Jottings,” *Portland Daily Press*, November 3, 1886, 4, CA.

<sup>552</sup> “Streets Commissioner’s Report,” *Portland Daily Press*, March 3, 1873, 3, CA.

sleighs, which in fact needed snow to function. Accordingly, the city long denied street railway executives' requests to use their cars for snow removal.<sup>553</sup>

Portland's approach to snow changed in the 1890s. Streetcars, especially after their electrification, became central to the protocol for plowing snow from roadbeds. The city began to focus its own snow and ice removal efforts on the middle of streets. "Sanding sidewalks" was the only expense of winter pedestrian caretaking named in the 1891 annual report.<sup>554</sup> With the public works budget already extended by various improvement projects, in 1892 the Portland council tried to shift sidewalk snow removal onto residents. They were already legally obliged to clear snow and ice from sidewalks but had perhaps never been so needed for this work as they were now that the city was building out the sidewalk system. The council ordered the city marshal to strictly enforce the law requiring owners or occupants of abutting properties to clear sidewalks. *The Portland Daily Press*, reporting this municipal recommitment, opined, "If the law is strictly enforced the great majority of citizens will rise up and call the marshal blessed, for there is no ordinance more generally disobeyed." Residents were to shovel within three hours of snowfall's end if during the day and before ten o'clock the next morning if the snow fell at night. Negligence could result in a not-insignificant fine of one to ten dollars (equivalent to \$350 in 2025), which could compound "each and every hour thereafter" that the sidewalk remained uncleared.<sup>555</sup> If a Portland property owner had no time for shoveling but did have some money on hand, they might flip to

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<sup>553</sup> On the connection between electrifying streetcars and a commitment to snow removal, see Heseltine, "Bangor Street Railway," 11-12. For an example of municipalities previously forbidding snow removal by street rail companies when the accumulation exceeded a specific depth, see *Charter and Ordinances of the City of Lewiston*, 145.

<sup>554</sup> "Portland's Streets: Work Done on Them in the Last Year," *The Portland Daily Press*, March 7, 1892, 5, CA.

<sup>555</sup> George L. Swett, City Marshal, "Snow and Ice on Sidewalks," and editorial note, "Clearing Off the Snow," *Portland Daily Press*, December 1, 1892, 8, CA. Most language of this ordinance remained the same even through an amendment in 1916. See, "Snow & Ice Removal" in City of Portland, *Supplement to Ordinances* (Portland, ME: Marks Printing House, 1922), 21-22, PWD.

the wanted ads and hire someone like the self-described “sturdy man” who, looking for work in October 1893, advertised that he could “keep your sidewalk clear from snow.”<sup>556</sup>

As far as the city budget was concerned, maintaining the proliferating sidewalk surfaces through winter continued to cost more even without public snow removal. The public works department spent nearly five percent of its 1895-96 fiscal year budget on snow and ice removal, and a good deal of that went to the sanding of sidewalks.<sup>557</sup> The bulk of sidewalk construction was yet to come, and the City had yet to annex the sprawling streets of Deering. Sanding alone continued to be the city’s practice through the turn of the century, though by 1907 the Public Works Department had returned to removing snow on select sidewalk stretches in addition to widespread salting.<sup>558</sup>

Like laws against bicycles, those requiring snow removal were difficult to enforce across multiplying pedestrian space, though at least homeowners could not just speed away. Timely clearance remained patchy. The *Portland Press* reprinted the ordinance in February of 1896 under the reproachful headline “Shovel Your Walks: Police Are Getting Weary of Complaints of Violating This City Ordinance.”<sup>559</sup> The *Press*, in a pitiable, perhaps sarcastic threat that likely revealed the sorry state of enforcement, added “If this thing keeps up, somebody will have to pay a fine pretty soon.” In fact, questions remained about just how a city could compel private property owners to do the public service of shoveling. An 1899 issue of the *Yale Law Journal* seriously considered what empowered cities to require snow removal by abutters.<sup>560</sup> However, shoveling laws did stand up to legal scrutiny, both according to

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<sup>556</sup> “Wanted—Situations,” *Portland Daily Press*, October 20, 1893, 11, CA.

<sup>557</sup> *Annual Report of the Commissioner of Public Works, Portland, Maine, 1895-96*, 39.

<sup>558</sup> *Annual Report of the Commissioner of Public Works 1900-1901*, 31; Office of the Commissioner of Public Works, *City of Portland Annual Report of the Commissioner of Public Works 1907* (Portland, ME: Marks Printing House, 1908), 5, PWD.

<sup>559</sup> “Shovel Your Sidewalks,” *Portland Daily Press*, February 21, 1896, 5, CA.

<sup>560</sup> William Frederic Foster, “Municipal Ordinances Relating to the Removal of Ice and Snow from Sidewalks,” *Yale Law Journal* 8, no. 8 (1899): 344-352.

the *Yale Law* article and, more powerfully, decades later in a 1918 unsuccessful challenge of one ordinance before the Missouri Supreme Court.<sup>561</sup>

Again, even timely snow shoveling could not always avoid or even help the worst cases of refreezing. In Portland, icy circumstances became even worse in the cement sidewalk era. One example came from a February 1898 storm that, like the 1888 Biddeford event described earlier, began as snow but turned to rain overnight. The next morning, rubber-clad pedestrians did their best to make it around town despite treacherous walking conditions. “By noon,” reported *The Daily Press*, “the sidewalks in many places resembled miniature ponds.” Those who wore tall rubber boots could travel somewhat normally while those with “ordinary overshoes could be told a long way off by the slow progress they made as they hunted for the spots over which they could pass dry shod.” It seems that in some places snow was keeping additional water off the sidewalk, and those who earnestly shoveled their sidewalks found that it “if anything made the sidewalks worse than they were before.”<sup>562</sup> They had only set up a more extensive surface of ice to be encountered by unfortunate pedestrians the next morning.

As in Boston some decades before, though shoveling snow and scraping away ice remained the abutter’s responsibility, the City of Portland was liable for any damages from sidewalks that did not properly and hospitably convey pedestrians. In the mid-1890s, these incidents became so common that the paper started regular printing a “Claims for Damages” column to enumerate them. The incidents, blamed on some combination of icy and broken sidewalk, frequently resulted in broken bones.<sup>563</sup> As a 1902 incident in Waterbury, Connecticut would illustrate well, beside the risk cement sidewalks created for incomplete clearing and refreezing, the surfaces’ hardness—otherwise one of the material’s selling points—increased the possible damage when a slip occurred. That February, Miss Mary Murnane experienced this first-hand when she fell while walking to work at a Waterbury brass factory. Her “head struck the

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<sup>561</sup> “Snow Removal Ordinances,” *The American City* 19, no. 4 (October 1918): 329.

<sup>562</sup> “Slush on Sea and Land. Portland City and Harbor Buried Several Feet in Snow and Water...One of the Most Disagreeable Storms in this Vicinity in Recent Years,” *The Portland Daily*, Feb 23, 1898, 8, CA.

<sup>563</sup> For example, see “Claims for Damages,” *Portland Daily Press*, January 8, 1895, 2, CA.

sidewalk with considerable force” such that she was “rendered unconscious for two hours.”<sup>564</sup> Small wonder that rubber manufacturers including L. Candee began selling more “foot holds” that covered only the balls and toes of a boot, with narrow straps over the top and around the heel to secure (Fig. 3.13).<sup>565</sup>

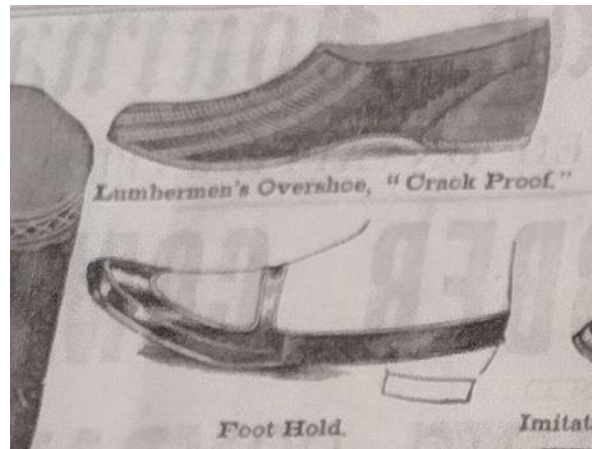


Figure 3.13. Comparison of a typical rubber overshoe’s extent of coverage and the much smaller “foot hold” meant as much for traction as it was for protection of the shoe and foot. From issue no. 35 of the *Rubber Trade Journal*, viewed at the Baker Library of Harvard Business School.

Other responsibilities that resulted from expectations for clear sidewalks had nothing to do with snow or ice, but they still implicated municipalities even when other entities were involved. Electric and telephone companies came under criticism when they placed their poles too far into sidewalks from the street edge, and cities heard complaints when the utilities had been allowed to do so.<sup>566</sup> Meanwhile, some local governments continued to build sidewalks of outdated materials such as planks, which presented different and perhaps greater dangers. This was a clear risk, with citizens willing to claim damages when a public walk, for example, tripped them and caused them to fracture their shoulder.<sup>567</sup> Moreover, plank or

<sup>564</sup> “City News,” *Waterbury (CT) Democrat*, February 28, 1902, 8, CA.

<sup>565</sup> L. Candee & Co., *Price List of the L. Candee & Company, New Haven, CT* (Boston: The Collins Press, April 1, 1895), Trade Catalogs, HBS.

<sup>566</sup> “Deering,” *The Portland Daily Press*, October 9, 1897, 2, CA.

<sup>567</sup> “Four Thousand Dollars’ Damages” and “Sidewalk for Preble Street,” in “South Portland,” *The Portland Daily Press*, April 12, 1900, 5, CA.

gravel sidewalks fell well below the standards of quick, easy, and clean pedestrianism that proliferating cement walks had started to shape.

### Concrete Sidewalk Cultures, Part II: New Footwear Steps onto the Street

As a region with regular snowfall, New England's examples of how cities and citizens dealt with winter precipitation upon their miles of new sidewalk lend insights that extrapolate well across the country's northern tier. At the end of the nineteenth century, New England was also the center of the American footwear industry. By then, the region had nearly three centuries of Anglo-American cobbler traditions, and production remained even as the sourcing of cowhides and the distribution of finished shoes spread out of New England and into the Trans-Mississippi West. Widening distribution meant that an increasing number of boots and shoes made in New England would be worn in landscapes that were decidedly not New England. Warmer, drier climates and different amounts of new, smooth pavements on which to move about invited different styles of footwear.

In this period, New England's shoemakers were dominant but not stable. Rapid corporate change involved both the founding of new footwear firms and the consolidation of older outfits. Illustrated advertisements, provided to shoe retailers and department stores or mailed directly to customers, developed into a major arena for competition. The goods were also changing, often reflecting the relative homogenization of urban environments to which concrete sidewalks contributed. Shoes were trending toward what one producer called "airy fairy creations for the whimsical," meaning lighter colors, more ornate patterns, and more delicate materials even for everyday shoes. The universe of footwear styles became so complex that the same manufacturer coined the term "modern shoeology" for the sizeable realm of knowledge that shoe retailers needed to accrue.<sup>568</sup> New pavements made American streetscapes

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<sup>568</sup> Parker Holmes & Co., *Fall Catalog 1904* (Boston), Trade Catalogs, HBS.

more predictably cleaner and smoother places to not only walk but perhaps also display one's own footwear style.

Even before cement sidewalks had become at all common in New England, some residents knew about how this infrastructure shaped mobility, recreation, and style in the enviable new urban environments of Southern California. In the late 1880s, a fresh Pasadena transplant wrote back to his hometown *Springfield (MA) Republican*. His reports, reprinted in papers throughout New England, described “miles of streets and avenues, cement sidewalks, elegant churches, business blocks, an opera house which would do credit to Boston, elegant villas and homes, a fine public library,” like a proper New England city “dropped down in a semi tropical garden, with perpetual summer.”<sup>569</sup> Another report made the same transregional comparison but noted, “leave out of the scene the boys coasting with their sleds and skates. (Boys skate here, but on roller skates on cement sidewalks and in rinks).”<sup>570</sup> Next to the obvious lack of snow and ice, a second discrepancy was the material of the sidewalks. Not only the ideal weather but also the ideal cement surfaces made roller skates work in Pasadena.

Most people did not get around Los Angeles County towns on skates, but more typical footwear there also began to reflect the warm, dry climate and modern surface conditions. Certainly, the shoe industry's new lighter, more delicate creations at first appealed more to Pasadena residents for everyday outdoor wearing than to New Englanders, many of whom still relied on sturdy leather or rubber boots through the end of the nineteenth century.<sup>571</sup> Even so, it was Massachusetts factories that began creating lighter footwear, including the sneakers that became a more or less climate-irrespective phenomenon across the twentieth-century United States. The emergence of this new footwear culture was in part a process of relegating rubber to the soles of shoes. There, the material served as a tread against the

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<sup>569</sup> “Pasadena, California,” *The Republican Journal* (Belfast, ME), December 20, 1888, 2, CA.

<sup>570</sup> “Winter in Pasadena, Cal.,” *Ellsworth (ME) American*, March 24, 1887, 4, CA.

<sup>571</sup> For reading footwear materials and design as a source of knowledge about environmental and social context, see Marie-Josèphe Bossan, *The Art of the Shoe* (New York: Parkstone International, 2004), 249-254.

ubiquitous concrete that had appropriated much of rubber's former responsibility to keep people's feet clean and dry. Rubber manufacturers' introduction of footholds rather than full rubber overshoes turned out to serve as metaphor for the shrunken, albeit still important role the material would play in urban footwear during the concrete sidewalk era.

In this era, many rubber footwear manufacturers tried to avoid the relegation of their products to occasional use during and immediately after weather events. The L. Candee & Co. of New Haven, Connecticut, is one example. Having rebuilt after an 1877 fire, Candee operated a new factory complex that occupied several blocks and was purportedly "the largest rubber establishment in the world." Its reliable "arctics," rubber ankle-high gaiters, remained popular into the 1890s. But by 1895, Candee had introduced several lower-cut rubber shoes, which revealed more of the shoe underneath, in an apparent attempt to combine sleek style with sufficient weather-proofness.<sup>572</sup>

In 1892, a number of rubber shoe manufacturers, including Candee, joined forces under the U.S. Rubber Company, a syndicate typical of the era. One year later, that organization controlled half the country's rubber shoe market, and by the decade's end the proportion would rise to three quarters. Footwear remained the dominant sector of the rubber industry. According to the analysis of Arlesa Shephard, scholar of fashion and textile technology, the rubber footwear industry had reached a sort of business maturity in these years.<sup>573</sup> This life-cycle approach to business history has been used to argue that the rubber shoe market was saturated. That, in turn, might explain the changes to styles and marketing that occurred at the turn of the century and the slowing of growth. It is true that costs of rubber shoe production rose in the early twentieth century. As Shephard documents, this was due in part to demand for raw rubber by other industries and in part to labor costs for a process that remained more reliant on handwork than other manufacturing. These factors no doubt contributed to the demise of

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<sup>572</sup> L. Candee & Co., *Price List of the L. Candee & Company*.

<sup>573</sup> Shephard, "L. Candee & Co. and the U.S. Rubber Shoe Industry."

everyday rubber overshoes after approximately 1910. But another factor existed where the rubber hit the road—or, the concrete sidewalk, as it were.

Some rubber footwear manufacturers succeeded in making a complete transition into twentieth-century styles. In 1896, two brothers named Frederick and Andrew Hood, sons of an established rubber executive, established one of these new and rapidly shifting footwear firms, the Hood Rubber Company. They built a new factory in Watertown, Massachusetts and by early December had released a catalog aimed at translating the Hood reputation into large purchases of their winterized shoes and boots by retailers.<sup>574</sup> Hood's production increased from 3,000 pairs a day in 1896 to 20,000 pairs a day in 1899.<sup>575</sup> In the years that followed, they navigated the increasing costs that bedeviled other makers of boots and overshoes. By adding new features and focusing on a high-end stock with novel, stylish shapes, Hood remained successful as a maker of all-rubber footwear (Fig. 3.14).<sup>576</sup>

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<sup>574</sup> “The New Hood Factory,” *The India Rubber World* 15 (October 10, 1896), 19, HBS; “New Trade Publications,” *The India Rubber World* 15 (December 10, 1896), 70.

<sup>575</sup> Pau Medrano-Bigas, “The Forgotten Years of Bibendum: Michelin’s American Period in Milltown: Design, Illustration and Advertising by Pioneer Tire Companies, 1900-1930” (PhD diss., University of Barcelona, 2015, trans. 2018), 2179-2181.

<sup>576</sup> “A New Hood Specialty,” *The India Rubber World* 18 (August 1, 1898), 298, HBS.

A NEW HOOD SPECIALTY.

THE Hood Rubber Co. (Boston) are evidently determined that their goods shall not only be first-class, but that they shall be distinctive in style. They have therefore arranged to manufacture and control exclusively the Bailey ribbed-back rubber. This rubber, which has many advantages, has already been fully described in THE INDIA RUBBER WORLD. An exceedingly interesting point about the handling of these goods is the fact that they will be marketed at list prices instead of at an extra price as heretofore. On second thought, perhaps it is as well to review the three special claims to consideration that this rubber makes.



1. The heel having a ribbed back, it protects the clothing from becoming wet or soiled on the under surface by breaking the suction which two smooth surfaces create when wet.
2. The ribs, being near together at the top and spreading over the heel to the bottom, serve to hold the rubber securely on to the boot and prevent it from slipping at the heel.
3. It prevents the breaking of the rubber at the heel where it first gives out, and a short fit cannot be forced on the wearer. It also secures the shape of the rubber until worn out.

Figure 3.14. A review of new products from Hood Rubber underscored how the company set out to stay relevant in waterproof footwear even as the shoe industry pivoted toward modern, sleek styles. Published in *The India Rubber World* 18 (August 1, 1898) and viewed at the Baker Library of Harvard Business School.

Hood began tailoring footwear to specific environmental settings. The company named its various models to match places that would communicate to customers and retailers alike just what this footwear offered its wearers vis-a-vis their context of weather and terrain. Lumbermen's models were named Ottawa, Ontario, and Huron. A "four-buckle snow excluder" went by Portland, and an all-rubber arctic was the Montana. Their fashion-conscious overshoes took more local names, including Allston, Brighton, and Plymouth. The list of "fine specialties" included the Harvard, Cornell, Princeton, and

Newport.<sup>577</sup> That final name, especially, a coastal town renowned for its yachting and upscale vacationers, was indicative of how American rubber footwear would transform after 1910.

Rubber and Canvas: The Tennis Shoe and the Boat Shoe Become  
Everyday Shoes

In spring of 1906, The Atlas Shoe Company of Boston offered a “sporting goods department” within its shoes for men. Their products incorporated rubber in a way that was novel to mass-produced footwear, as a replacement for the layers of leather that typically constituted a shoe’s sole. Among the styles for a more general sporting—rather than for bicycling or turf sports like football—several had rubber soles either standard or optional. Over in the Atlas ladies’ department, rubber heels came standard on “comfort shoes” designed specifically for nurses to wear. Rubber had become recognizable as a source of traction and padding for people who moved about on smooth, hard surfaces whether indoors or out.<sup>578</sup>

British manufacturers had developed rubber soles specifically for lawn tennis more than two decades prior.<sup>579</sup> In 1884, Joseph Vaughan, a British citizen then living in Newark, New Jersey, had filed successfully to patent a “rubber sole for shoes.”<sup>580</sup> The corrugated rubber sole was not stitched directly to the leather or canvas upper body but rather adhered to a canvas insole with a water-tight cement. He intended the shoes for “use chiefly in active athletic exercises” and the managed surfaces of gymnasiums or courts where those exercises took place. However, Vaughan imagined cementing rubber outer soles onto “any old or new shoes” as a means of traction for urban pedestrians. This vision did not become

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<sup>577</sup> “Net Price List of Hood Rubber Company, February 1, 1904, to May 31, 1904,” pamphlet printed for William H. Walker & Co., Buffalo, NY, Trade Catalogs, HBS.

<sup>578</sup> The Atlas Shoe Company, Boston, “Rice & Hutchins’ Shoes for New England Retailers: Catalog No. 16” (Spring 1906), 31, 42, Trade Catalogs, HBS.

<sup>579</sup> Thomas Turner, *The Sports Shoe: A History from Field to Fashion* (London: Bloomsbury Visual Arts, 2019), 16-22.

<sup>580</sup> Joseph Vaughan, “Rubber Sole for Shoes,” US Patent 306,561, filed February 23, 1884, and issued October 14, 1884, HBS.

reality and rubber-soled shoes were neither widely reproduced in the United States nor worn far beyond tennis courts until after the turn of the century.<sup>581</sup>

In 1913, Hood's workers were still producing all-rubber winterwear and its executives and salespeople were still selling the products. But something else was also afoot. The company released a separate summer wear price list consisting almost entirely of tennis shoes. Hood was greatly expanding on what Atlas had done with rubber soles, thereby popularizing the rubber-soled athletic shoe. Hood began producing and marketing rubber-soled tennis shoes as part of their established practice of tailoring shoes to an environmental experience. In the case of their 1913 tennis shoes, none of those places was a traditional tennis court of closely cropped lawn. Instead, the shoes graced athletic and yacht clubs or remote sites of upscale recreation and leisure including famous conservation landscapes and beaches. Each page of the 1913 catalog featured a different tennis shoe on the top and a scene of diversion on the bottom, with all the characters uniformly vivacious and affluent white people save the rendering of a ghost dance performance by Sioux Indians in North Dakota (Fig. 3.15). The Lakeside model's page depicted canoers in the Adirondacks, the Heel Tennis model showed a horseback party on a fully outfitted trip in Yellowstone National Park. A model named "Holiday" was accompanied by an elegant young family outside New York's new Grand Central Station. In each of these settings, the wearers either did not think wet feet were likely or simply were unconcerned with the prospect.<sup>582</sup>

The new Converse Rubber Shoe Company of Malden, Massachusetts, was an especially late entrant among producers of fully winterized footwear. Incorporated in 1908, Converse hedged its bets and ended up on the same track as Hood. Alongside tall boots, stylish overshoes, and the sturdy mid-height rubbers known as lumbermen's, the company offered a handful of diverse products. Among these was a rubber heel they called the Rabbit's Foot that could supplement or replace the same part on any pair of

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<sup>581</sup> "Chapter 2: Sports Style, Youth, and Modernity," in Turner, *The Sports Shoe*, 44-71.

<sup>582</sup> *Net Prices to Retailer of Tennis Shoes Manufactured by Hood Rubber Company, August 1st, 1913*, printed for Pilgrim Shoe & Rubber Co., Boston, HBS.

shoes. Converse also produced tires, an offering that Harvard business professors would later point to as a mistake from which their students should learn.<sup>583</sup> The alternative investment that did pay off for the company were their lines of tennis shoes. Given that one 1914 model was called the Yachting, as with Hood, these shoes were clearly for more than tennis. Canvas-topped, rubber-soled shoes had become more broadly associated with recreation and leisure in general, and they clearly had potential for wearing anywhere that comfort, breathability, and a little traction were desirable qualities for a shoe.<sup>584</sup>

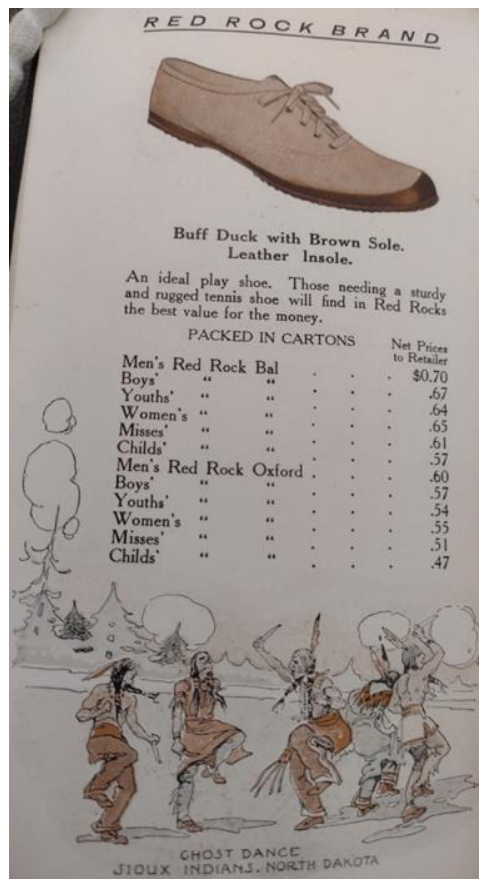


Figure 3.15. The Western reference of Hood Rubber's "Red Rocks" line of casual shoes was complemented by an illustration of the Sioux dancers whose performance the wearer might attend while on vacation. Published in the booklet *Net Prices to Retailer of Tennis Shoes Manufactured by Hood Rubber Company, August 1<sup>st</sup>, 1913*, and viewed at the Baker Library of Harvard Business School.

<sup>583</sup> "PF-1927, Ch. X-2: Converse Rubber Shoe Company," Cecil E. Fraser Papers, Arch GA 30.1, Box: 4, Folder: 23, HBS.

<sup>584</sup> Converse Rubber Shoe Co., *Season 1914* (Lynn, MA: Perry & Searle, 1914), Trade Catalogs, HBS.

Rubber soles, offering a better foothold on solidly paved sidewalks, had even become a new practicality of outdoor footwear in the urban United States. Except during strong precipitation, practical footwear might now mean shoes that could grip the pavement and were otherwise lightweight to facilitate free movement. This was quite a change from the narrow nineteenth-century definitions of practical footwear as thick, high-cut leather that guarded against damp feet and their attendant illnesses. Cement sidewalks had created a space in which lighter rubber-soled shoes might seem sensible for outdoor walking to any given American, at least in nice weather. At the same time, they pushed a standard ideal of the walking environment to which some region's cities still seemed better suited than other. When a Mainer visiting St. Augustine, Florida, in 1915 wrote back to his local paper, he raved about the weather by noting that "even when it rains one does not wear rubber-shoes." There were never puddles on account of how quickly the sidewalks dried and how well the neighboring sandy soil drained.<sup>585</sup>

### Conclusion

Cement sidewalks were initially laid down in US cities for several reasons. They were a novelty, a mark of modern street improvements that replicated old flagstone pavers in a remarkable new way. They were a smooth and much longer lasting alternative to bricks or planks, both of which required nearly constant piecemeal replacement or repair. But always, they were an extremely effective barrier between people above and the dirty earth below. Likewise, they prevented precipitation from mixing with that earth to create mud, the bane of all transportation by wheel and foot. Those qualities of cement surfaces were apparent immediately. Somewhat less predictably, those surfaces became integral to designing urban greenspaces, developing middle-class neighborhoods, and turning the sides of most city blocks into platforms for entering and exiting cars. Cement sidewalks, patchy though they remained in some cities, supported an ideal of pedestrian space that led to many ordinances and public calls for enforcing the

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<sup>585</sup> "Winter in St. Augustine," *The Republican Journal* (Belfast, ME), April 11, 1915, 3, CA.

same. Furthermore, the history of cement surfaces became important to the history of changes in footwear. The shoes that became popular for everyday wear in America assumed a clean and dry environment that cement sidewalks helped provide, even in parts of the country where weather and natural drainage were often inimical.

This history also provides insight into what sidewalks are and what they are not today. In US cities, it is quite common for cement sidewalks to cover block after block, interrupted only where the walking path, typically demarcated with white paint but occasionally still by a distinct crosswalk material, traverses an asphalt street. This gives the illusion that sidewalks are the pedestrian version of vehicular public transportation networks and should be likewise maintained and regulated for efficient movement from place to place. In many cases, some as a direct result of the Americans with Disabilities Act of 1990 (ADA), sections of sidewalk do connect and facilitate that sort of smooth, uninterrupted traffic. Often enough, however, following sidewalks in US cities is a far less predictable way of getting from point A to point B. There are patches of spalling or upheaved concrete, a kid's bike or a sandwich board is left in the sidewalk as it never would be in the middle of a street, or a block at which the vehicular road continues but the sidewalk simply stops. Another significant category of sidewalk issues today includes the intense debates over how to address the rising unhoused populations, who when left no option but to sleep outside often prefer to do so atop dry and sturdy concrete.

Today's questions about for whom and for what sidewalk spaces exist, and related ongoing efforts by US cities to comply with ADA guidance, can be most knowledgeably discussed in the context of historical disparities and disconnections in quality sidewalk construction. Cement sidewalks emerged during a tumult of municipal growth, transportation changes, and improvements that rationalized and sanitized urban environments. Despite the public nature of those developments, private property owners often held the power over their respective lots during initial sidewalk construction. Municipal governments did have ultimate power over sidewalk development. But especially outside of a core business district, there was typically no networked plan for this form of mobility infrastructure. And so,

rather than paving the way to a modern walking city, many concrete sidewalks instead opened new niches for individual fashion and recreation in the car-friendly US cities of the twentieth century. City public works departments will, no doubt, be re-examining their uses of conventional cement for concrete walking surfaces in light of climate change concerns, if they have not begun to do so already. It would be wise if they were encouraged to simultaneously advance pedestrian infrastructures as equitable and useful networks for navigating urban space.

FROM SICKLY CELLARS TO BENEFICENT BASEMENTS:  
HEALTH, RESPECTABILITY, AND HOUSEWORK IN THE  
DOMESTIC SUBTERRANEAN OF THE NORTHERN UNITED  
STATES, 1850-1930

By 1930, the terms *cellar* and *basement* were widely understood as contradictory for describing the excavated space that might exist under a home in the United States. The recently redefined *basement* was a space that broke with decades of explicit distinction between the undesirable underground and the respectable aboveground, which was both literally and figuratively elevated, in popular conceptions of residential space. In homes built on a slope, this division of cultural expectations for domestic space relative to the ground level could be apparent within the same building. That was certainly true of a new San Francisco home featured in a 1905 issue of *Good Housekeeping*.<sup>586</sup> At its front, the home's bottom floor was largely belowground. Accordingly, it was utility space, in this case including a laundry room and sleeping chamber for a live-in maid. At its rear, however, the level was entirely above ground. That end featured an elegant library with built-in bookcases and a cozy fireplace, where the homeowner might read and look out the back window. The lowest level's drastic change in function relative to the surrounding grade demonstrated a mutual exclusivity between underground spaces and classy aboveground areas for leisurely living.<sup>587</sup> Yet when this house was built, developments in home construction and domestic labor were beginning to blur such long-standing architectural conventions, and with them, the ways that ideas and practices of gender and health functioned beneath American homes.

During the sanitary movement of the mid-1800s and into the later Progressive Era, public health advocates upheld the distinction between what was above ground level and what was below it. They

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<sup>586</sup> Mabel Craft Deering, "A House on a Narrow Lot," *Good Housekeeping* 41, no. 4 (October 1905): 356-360, WMA.

<sup>587</sup> For another example of hillside contingencies in designating underground space, see the distinction between cellar and basement in Palliser, Palliser, & Co., *Palliser's American Home Cottages* (New Haven, CT: L.S. Punderson, 1878), 58-59.

decried the squalor of cellar dwelling, which they associated with economic and moral poverty. Their negative attitudes toward lower-level apartments reflected a miasmatic understanding that dark, damp, and ill-ventilated spaces bred disease. Though exact concerns about the cellar's consequences to moral and physical health shifted over time, a throughline among reformers was their projection of holistic environmental health concepts into tenement cellars. John Hoskins Griscom, the Manhattan physician whose voice often rang loudest among American reformers of the sanitarian era, charged, for example, that cellar apartments were deforming and debilitating the babies who lived in them.<sup>588</sup>

However, Griscom, who died in 1874, lived into a new era when cement use under American homes was effecting changes that first qualified cellar denunciations and then allowed for a clearer distinction between *cellars* and *basements*. For most of Griscom's life, builders only rarely and sparingly applied cement below homes. After 1850, however, cement use in cellars steadily increased, first for flooring and then as the standard binder for brick or stone foundation walls under the new single-family homes or flats of the growing middle class. The fully excavated cellar level also became more common, at least in regions where the trifecta of frost heaves, furnaces, and fuel storage justified such an undertaking.<sup>589</sup> Architects began dividing this large space into designated spaces for laundry, heating apparatuses, and various stored goods, not least including coal and garden produce.<sup>590</sup>

By the turn of the century, cement and concrete in cellars were widely credited with excluding rainwater, sewage, rats, and earthy stink. In these ways, domestic advice writers contended that generous application of cement secured a healthful environment for the home above. More certainly, concrete floors and cement-coated walls changed what people experienced when they ventured below new homes. Sturdier walls could support casements for daylight windows or even window wells, and the relatively

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<sup>588</sup> John H. Griscom, *The Uses and Abuses of Air* (New York: J.S. Redfield, 1848), 184.

<sup>589</sup> *Palliser's*, 28.

<sup>590</sup> *Palliser's*, 63. See also, D.S. Hopkins, *Late Victorian House Designs: 56 American Homes and Cottages with Floor Plans* (Mineola, NY: Dover Publications, 2004). For a later example of a self-proclaimed ideal basement floor plan, see Grace Irene Chapin, "A Well Planned Basement," *Good Housekeeping* 36, no. 3 (1903): 281, WMA.

dry space could safely house a central furnace, which further altered the environment with radiant heat and ventilation. Though less perfectly than sometimes advertised, cement did help lessen undesirable smells, sights, and tangible sensations from seeping gases and liquids or crawling critters. In this sense, cement surfaces in the domestic subterranean were a realization of progress, which, as historian Gabriel Lee has documented, made concrete structures a defining feature of attitudes and experiences in the Progressive Era.<sup>591</sup> But the simultaneous development of *basements* in an emerging ideal American home demonstrates that cement, via its physical effects, had deeper cultural consequences. A competent excluding perimeter often made underground environments so pleasant as to be inviting to new users, who then challenged existing notions of who belonged in cellars and experimented with new practices in that domestic space.

Rigid division between healthy homes and the subterranean crumbled as a new type of underground living space became not only acceptable, but aspirational. Modern parents integrated the underground into existing concepts of the single-family home as a retreat from the exterior chaos of industrialized society.<sup>592</sup> Mothers forcefully contradicted the sanitarians of yore by embracing basements as safe, comfortable, and beneficial to children's development. Architects and other professionals also dropped prejudices against the subterranean, approving of underground play by drawing recreation rooms into floorplans or by electrically wiring the space with family use in mind.

These changing attitudes, of course, had much to do with the preceding technological and environmental changes by which cellars had been replaced by basements. The old earth-floored, rat-infested underground storage chamber and the new cement-bounded suburban rec room hardly deserved the same title. Indeed, Progressive Era building codes began to clearly distinguish between cellars and basements. By the 1910s, cellar was widely known as a dankly pejorative term for pre-modern spaces

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<sup>591</sup> Lee, "Concrete Dreams: The Second Nature of American Progressivism."

<sup>592</sup> Kirk Jeffrey, "The Family as Utopian Retreat from the City: The Nineteenth-Century Contribution," *Soundings: An Interdisciplinary Journal* 55, no. 1 (1972): 21–41; Clifford Edward Clark, *The American Family Home, 1800-1960* (Chapel Hill: University of North Carolina Press, 1986), 72.

with less tightly bounded ecologies.<sup>593</sup> The cement-sealed space under a new single-family home was increasingly referred to as modern basements. This repurposed a term that in early nineteenth century had typically described the lowest level of a multistory building that was *not* a cellar.<sup>594</sup> Often hosting commercial or social activities, possibly with residential floors above, the basement was distinguished from the cellar by being mostly if not entirely above ground.

To be sure, many uses of the old cellar translated to the new basement. Yet families with modern basements quickly discovered they could relocate other activities into the lower level. All these activities took new forms when adapted to the cement-sealed lower level, and new experiences informed new imaginations and new ideals. American conceptions of motherhood, practices of household economy, and, more generally, aspirations to life in the single-family home were all influenced by the perceived possibilities within modern basements. This chapter is an origin story for the modern home basement. It recounts how liberal use of cement, by effecting a much tighter seal against many undesirable subterranean elements than had previously been possible, created new underground spaces that many mothers deemed sanitary, families experienced as comfortable, and Americans broadly accepted as potential living areas.

Though many Americans came to willingly recreate and relax underground, this was not a preconceived goal that they realized by application of cement. Rather, they first cemented cellars to keep rats out of vegetables, moisture out of coal, and water within cisterns. Builders in many locales further cemented foundation walls to stabilize the house's above-ground framework against seasonally shifting soil. Only subsequently did cement's regulation of the underground environment invite many Americans to willingly imagine spending more time underground. They then individually and collectively probed the

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<sup>593</sup> One popular manual for home construction had this index entry for Cellars: "See Basements." L. Eugene Robinson, *Domestic Architecture* (New York: The MacMillan Company, 1917), 381.

<sup>594</sup> For examples of aboveground basements, sometimes over what was termed an "undercellar," see "Notice," *The Portland (ME) Gazette*, May 11, 1824, 3, CA; "Auction Sales," *The Portland Gazette*, September 18, 1821, 3, CA; "Howard's Hotel," *The Pilot and Transcript* (Baltimore), June 4, 1840, 3, CA.

possibilities that the cement underlaying their homes had generated. Cement came to not only assist existing practices of home economy, but also to invite housewives and others into new practices of domestic life.

### The Ruinous Underground

In the sanitary movement that took hold in England during the 1830s and was shortly adopted by civic leaders in the United States, dwellings that were at ground level or below it, especially those located in urban cores, gained notoriety. The most scrutinized among such residences occupied the lowest levels of tenements—the residential buildings that landlords subdivided into the smallest marketable rental units.<sup>595</sup> Landlords in industrializing cities wanted to crowd renters into each building to maximize profit, and some tenants embraced the model as a means to the cheapest rents in town, even if the value was poor. Tenement logic required renting out space even if it was partially or entirely below ground level. Fairly or not, these cellar apartments were known as sickly places to which the most impoverished of all residents were subjected to make their homes. They were also a sticking point in the decades of architectural reform by which issues of poor lighting and ventilation were somewhat mitigated in the above-ground stories of many tenement houses.<sup>596</sup>

The bulk of nineteenth-century underground rooms, tenement or otherwise, were truly no place in which most people would want to linger. They were often windowless, uncomfortably moist, and literally dirty. For much of the year, they were too cold for comfort. Besides, they were exceedingly liable to harbor spiders, rats, and other crawling or scurrying organisms. Furthermore, underground rooms were subject to foul intrusions from nearby cesspools—the private, imperfectly enclosed pits that remained a

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<sup>595</sup> For an example of a typical process by which landlords transformed a building into rental units, see Zachary J. Violette, “The Decorated Tenement: Working-Class Housing in Boston and New York, 1860-1910” (PhD Diss., Boston University, 2014).

<sup>596</sup> Benjamin Orange Flower, *Civilization's Inferno: Or, Studies in the Social Cellar* (Boston: Arena Publishing Company, 1893), 65-71; Lawrence Veiller, *Housing Reform: A Handbook for Practical Use in American Cities* (Philadelphia: William F. Fell Co., 1910), 24, 45, 118-119.

common mode of managing excreta, either by periodic emptying or by slowly leaching into the surrounding earth, until US cities completed cement sewer projects toward the century's end.<sup>597</sup> The social reformers who led campaigns of both charity and legal action against cellar dwelling believed that not even the most hapless immigrant, nor even the incarcerated, deserved filthy underground living quarters. As demonstrated in chapter two, by the mid-1800s cement had already affected prison reform and many realities of incarceration. Cement had not, however, been so widely deployed underneath buildings.

Sanitarians held a moral consensus that no child should spend significant time in such spaces. The darkness of the spaces alone was troubling to the many nineteenth-century Americans who understood light to be an important element of a healthful environments.<sup>598</sup> But they had more specific concerns, as John Hoskins Griscom articulated in his 1848 laments that some immigrant children in New York spent most of their day poorly ventilated underground rooms.<sup>599</sup> They slept in cellar apartments and then woke to attend public schools where cellars had been converted into classrooms, a slapdash accommodation for a ballooning youth population. Griscom especially disapproved of schools where the youngest grades were held in the cellar, because the youngest had the most developing in front of them. He primarily blamed New York officials for the cellar schoolrooms, but also stated "no sensible parent would send a child to the stupefying atmosphere of a basement."<sup>600</sup>

Griscom worried especially about "those unfortunate infants who are parentless" and were thusly assigned by the city's Alms House to fostering women called out-nurses. He claimed "those children will very often be found pining in dark, damp, ill-ventilated basements."<sup>601</sup> Exactly which infants had been subjected to those spaces was clear to Griscom "from their appearance alone," manifested in

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<sup>597</sup> Tarr, *The Search for the Ultimate Sink*; Melosi, *The Sanitary City*.

<sup>598</sup> J.A. Peterson, "The Impact of Sanitary Reform upon American Urban Planning, 1840-1890," *Journal of Social History* 13, no. 1 (1979): 83–103.

<sup>599</sup> John H. Griscom, *The Uses and Abuses of Air*, 184.

<sup>600</sup> Griscom, *Uses and Abuses of Air*, 178.

<sup>601</sup> For the long history of health experts scolding common people for not getting enough fresh air, see Peter C. Baldwin, "How Night Air Became Good Air, 1776-1930," *Environmental History* 8, no. 3 (July 2003): 412-429.

“unshapeliness of the head, the dilation of the pupils of the eyes, the distorted and sunken eye-balls, . . . and in a word that general ‘unearthly appearance’ which, in the days of superstition, used to excite the apprehensions of the good women, that their offspring were under the influence of evil spirits.” Griscom more than pitied the discomfort experienced by basement babies. He also feared for their human development.

Such worries about cellars echoed a long Anglo history of turning observations and experiences of environments into prejudices of class and gender.<sup>602</sup> At the same time, their worries conveyed environmental concerns particular to the period. Griscom’s comments likened suspect out-nurses to past women who had been accused of both social transgressions involving perceived unclean living and criminal behavior that included damaging children’s bodies.<sup>603</sup> However, sanitarians presented the two forms of misbehavior as one in the same rather than unifying them via witchcraft as their colonial predecessors had done. In casting environment as a direct cause of bodily differences, sanitarians were in part interpreting and applying theories by British and French natural philosophers regarding how the physical characteristics of living things transmuted according to factors like climate and daily activities. Griscom’s conviction that cellars themselves altered people’s bodies in a matter of days, weeks, or months would soon conflict with scientific consensus. Charles Darwin was quietly drafting a theory of organisms’ long-term mutability under environmental influences and others including Louis Pasteur, motivated by cholera outbreaks and infected wounds, were laying the foundations for a strict germ theory of disease. However, Griscom’s notion that basements contained essential and immediate threats was supported by

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<sup>602</sup> For an account of how dirt and mud in domestic spaces affected class definitions, gendered relationships, urban-rural distinctions, and colonial rationale in British-ruled Ireland throughout the eighteenth century, see Colleen Taylor, *Irish Materialisms: The Nonhuman and the Making of Colonial Ireland, 1690-1830* (Oxford University Press, 2024), 143-218.

<sup>603</sup> Mark Fiege, *The Republic of Nature: An Environmental History of the United States* (Seattle: University of Washington Press, 2012).

popular theories of environment-inflicted ailments that historians have documented across the nineteenth-century United States.<sup>604</sup>

Many anti-cellar health messages returned to concepts of development, not only biological but also intellectual and moral. They articulated a logic by which ventilation led, via lower morbidity, to lower-class and incarcerated people becoming more productive members of society. Despite regularly blurring what was medically beneficial with what he judged to be proper, upstanding behavior, Griscom and like-minded reformers contributed to new concepts of environmental equity that would stand the test of time or resurface.<sup>605</sup> Sanitarians were no doubt in mind when police, announcing a jail under a new Brooklyn station, emphasized the cells were nonetheless humane because their construction left them unusually dry and well ventilated.<sup>606</sup>

Though some reformer claims and insinuations regarding underground dwellings appear unfounded today, many threats that cellars posed to physical comfort and health remain indisputable. An 1854 domestic architecture book subtitled “Homes for the People” hoped one source of these threats, the cesspool, would “be soon reckoned among the obsolete mistakes of our forefathers.” Near-universal efforts and attitudes around city sewerage in the subsequent generation would answer that prayer. Until then, too often careless construction meant cesspools’ “contents... rapidly permeate[d] the surrounding soil,” meaning the pits themselves barely accumulated human waste “until the whole neighborhood [became] fully saturated with the drainage.” Meantime, the waste would “ooze through and appear upon the surface, or find its way through some defective foundation, and poison the basement of an adjoining

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<sup>604</sup> See Conevery Bolton Valencius, *The Heath of the Country: How American Settlers Understood Themselves and Their Land* (New York: Basic Books, 2002); Gregg Mitman, “In Search of Health: Landscape and Disease in American Environmental History,” *Environmental History* 10, no. 2 (April 2005): 184-210.

<sup>605</sup> Griscom, *The Uses and Abuses of Air*, 179.

<sup>606</sup> “Brooklyn,” *The New York Daily Times*, October 1, 1851, 1, accessed via the TimesMachine.

building.”<sup>607</sup> This revolting scenario indicated that basement space was uncomfortable and unhealthy because too much matter was moving too freely underneath the surface in residential areas.

The historian of environmental justice Dawn Day Biehler notes that threats of basement sewage remained high well into the twentieth century for residents of older and cheaper construction, like the tenements on Chicago’s near West Side.<sup>608</sup> Historian of urban immigration A.K. Sandoval-Strausz has found evidence that in those same neighborhoods lingering environmental vulnerabilities of basement apartments, including flooding and rat infestation, were experienced by working-class African-Americans and Latino residents into the 1970s as they repopulated ethnic Eastern European neighborhoods.<sup>609</sup>

### Cement Begins Modernizing the Cellar

In locations with cold winter temperatures, the goal of home stabilization justified the costly work of excavating below the frost line and setting a foundation.<sup>610</sup> In such places, a wooden structure set directly on top of the ground would settle and warp in synchrony with soil heaves caused by freezing and thawing, and this compromised the building’s endurance, safety, and function. Manuals and treatises standardized foundations in the mid-nineteenth century, instructing builders to guard against frost by meeting specifications of depth and materials.<sup>611</sup> At the time, materials meant bricks or stones, ideally cut stone though in practice many builders used fieldstones found on or near the site. These masonry units were to be united by mortar.

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<sup>607</sup> John Bullock, *The American Cottage Builder* (New York: Stringer & Townsend, 1854), 205.

<sup>608</sup> Dawn Day Biehler, *Pests in the City: Flies, Bedbugs, Cockroaches, and Rats* (Seattle: University of Washington Press, 2015), 33.

<sup>609</sup> A.K. Sandoval-Strausz, *Barrio America: How Latino Immigrants Saved the American City* (New York: Basic Books, 2019), 185.

<sup>610</sup> Wisconsin Historical Society, “Historic Building Foundations,” <https://www.wisconsinhistory.org/Records/Article/CS4215>, accessed September 19, 2024; Even today and even when discussing basement permeability, home construction experts point out that a basement is primarily an investment in a house’s structure. See Joseph W. Lstiburek, “Keeping the Water Out of Basements,” *ASHRAE Journal* 61, no. 3 (March 2019): 62-63.

<sup>611</sup> John Millington, *Elements of Civil Engineering* (Richmond, VA: Smith & Palmer, 1839), 612.

As noted in chapter one, hydraulic cement was costly relative to traditional mortar materials in the mid-nineteenth century. True hydraulic cement, as well as its water-resistant approximations, were most obtainable near one of the country's handful of established cement production sites.<sup>612</sup> Further complicating American use of cement in the cellar, texts that advised on domestic architecture were often British publications distributed and read across Anglophone societies in North America. When one such text advised cement for lining cesspools and creating “stink traps” or “vermin traps,” it named Parker’s cement and Dorking lime—respectively, the proprietary natural cement product described in chapter one and a source-specific English cement that American builders may not have known to be hydraulic.<sup>613</sup>

In fact, into the century’s final decades, concrete remained rarely used for homes’ foundation walls. Prior to the era, described in chapter one, of engineering structural concrete and testing its compressive strength, some experts questioned the very idea that cement could be the basis of foundation construction.<sup>614</sup> That was brick or stone’s role. Cement played a different part, as a thin but dense barrier against water, vermin, and bad airs.

“Cemented Cellars,” read the title above a paragraph in the variety section of Bath, Maine’s daily *Eastern Times* in the fall of 1852.<sup>615</sup> This brief how-to on modern cement was one of many distributed via informal syndication, here from *The Genesee Farmer*, an upstate New York periodical with tens of thousands of subscribers.<sup>616</sup> This bit of information figuratively trickling through the Northeast gave advice for stopping literal trickles, and other unwanted movements, through the space under one’s home. The piece described cement barriers as assets to the existing practices of using cellar space for storage in the economy of an American household. Laid properly, a cement layer would be cohesive and extensive

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<sup>612</sup> Lee, “Concrete Dreams,” 31-32.

<sup>613</sup> T. L. Walker, *Architectural Precedents*, 3rd ed. (London: Library of Fine Arts, 1841), 13, 26, 46, 104.

<sup>614</sup> *Palliser’s*, 11, 13.

<sup>615</sup> “Variety,” *Eastern Times* (Bath, ME), October 28, 1852, 4, CA.

<sup>616</sup> On *The Genesee Farmer’s* readership and journalism practices, see Charles L. Flint, et al., *Eighty Years’ Progress of the United States from Revolutionary War to the Great Rebellion* (Chicago: O.F. Gibbs, 1864), 98.

enough to exceed rats' ability to "excavate beneath it, and then crack it off by piecemeal." Thereafter, a cellar would continue for years to be a dry, safe storage place for "fruit, vegetables, and other articles." The floor described was effectively *concrete*, though that term was not in common use and the technique remained rare. Certainly, what the term *cemented cellar* described was an intermediary between the relatively unbounded ecology of cellars and the fully concrete foundation that remained more than a half-century removed from being standard in American home construction.

After 1850, with hydraulic cements steadily becoming more available in hardware stores and lumber yards across the country, guidance on cement use underground became more common if, at first, still minimalist.<sup>617</sup> The goal remained to impede movement of mischievous environmental elements, for instance keeping water from wicking up through a brick foundation and into the wooden framework above. On this topic, an 1854 manual acknowledged hydraulic cement still was not accessible to all and permitted that a builder could substitute a layer of similarly water-retardant zinc or slate atop the brickwork.<sup>618</sup>

Even with access improving, cement use remained unaffordable in much home construction, such that the amount of cement in a cellar contributed to class distinctions—distinctions that began with whether an underground level existed at all. The cost of human-powered excavation proved prohibitive to most members of the working class who built or arranged to build their own homes.<sup>619</sup> At the opposite extreme, wealthy Americans excavated wall-to-wall beneath their homes and therein employed hydraulic cements for everything from sealing a private water supply to securing a proper environment for wine

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<sup>617</sup> For cement production's increase in these decades, see for example the four-fold rise from 1850 to 1870 at Rosendale, New York, the standard-bearer of domestic production in that era: Thomas E. Rinaldi and Robert J. Yasinsac, *Hudson Valley Ruins: Forgotten Landmarks of an American Landscape* (Lebanon, NH: University Press of New England, 2006), 132.

<sup>618</sup> A.C. Smeaton, *The Builder's Pocket Manual* (London: M. Taylor, 1854), 61.

<sup>619</sup> George Smith, *Essay on the Construction of Cottages Suited for the Dwellings of the Labouring Classes* (Glasgow, UK: Blackie & Son, 1834).

storage.<sup>620</sup> Into the 1870s, cemented cellar features were a rare luxury. By the 1880s, however, homes for the growing middle class included cemented cisterns, floors, and sewage structures in both urban and rural settings throughout the Northeast and North Central regions.<sup>621</sup> White middle-class America was hot on the heels of the elite cemented cellar vanguard, fueling a gradual but relentless incorporation of the material under American homes. However, cement had not yet been widely applied and experienced enough to alter cellars' collective reputation.

### The Beat Against Cellar Dwelling Goes On

Progressive reformers largely picked up where earlier sanitarians had left off with denunciations. However, cellar dwelling became less a pity in need of charity and more a failure in need of admonition. The gradation of cellar environments to which modern building materials were contributing must have only heightened popular notions of successively better housing as something a hard-working person should obtain in good time. And yet, as Progressives and muckrakers noted and many recent immigrants bemoaned, millions of Americans seemed stuck in the same dirty old cellars. In some cases, it seems the working-class accepted and internalized the idea that living in a cellar was the ultimate shortcoming.<sup>622</sup>

New York City developed tenement regulations in the 1870s that specifically targeted cellar living. Reflecting on this in his 1890 *How the Other Half Lives*, Jacob Riis wrote that “[after five years of efforts] the department succeeded at last in ousting the ‘cave-dwellers’ and closing some five hundred and fifty cellars south of Houston Street, many of them below tide-water, that had been used as living

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<sup>620</sup> Examples of cemented cellar floors in plans and descriptions of high-end real estate include “House for Sale,” *Eastern Times* (Bath, ME), June 22, 1854, CA; “For Sale & To Let,” *The Portland (ME) Daily Press*, May 2, 1863, CA; “Valuable Real Estate at Auction,” *The Portland Daily Press*, May 8, 1863.; Woodward’s, 116.

<sup>621</sup> William Paul Gerhard, C.E., “Sanitary Questions,” in A.W. Brunner, ed., *Cottages or Hints on Economical Building* (New York: William T. Comstock, 1884), 33-54; William Paul Gerhard, *The Disposal of Sewage of Isolated Country Houses* (Indianapolis: William B. Burford, 1891).

<sup>622</sup> For example, see the anecdote about an Irish immigrant who had from afar thought her uncle was doing well in the United States but instead “found him living with his large family in a dark basement.” Aunt Patience, “Just Among Ourselves,” *Ladies' Home Journal* 8, no. 9 (August 1891): 18, WMA.

apartments (Fig. 4.1). In many instances the police had to drag the tenants out by force.”<sup>623</sup> Residents sometimes joined landlords in opposing the anti-cellar actions, not because they enjoyed such environments but because they reasonably feared that alternatives entailed additional or unknown hardships.



Figure 4.1. Sketch of a tenement in obvious disrepair. The dark void of a basement is advertised for rent. Illustration originally printed in Riis, *How the Other Half Lives*, 176.

Riis’ account demonstrates how reformers continued to ascribe human behaviors to qualities of underground built environments. By 1890, concerns regarding residential spaces had been joined concerning social spaces, notably the illegal taverns located in cellars on New York’s Lower East Side. Accompanying a police raid in one tavern, Riis described “walls and ceiling...covered with a brown crust that, touched with the end of a club, came off in shuddering showers of crawling bugs, revealing the blacker filth beneath.” Riis could not be certain whether this same filth had accumulated on the floor or “if indeed there was other floor than hard-trodden mud.” In other cellar dives, “the filth and the stench

<sup>623</sup> Jacob A. Riis, *How the Other Half Lives: Studies Among the Tenements of New York* (New York: Charles Scribner’s Sons, 1890), 16.

were utterly unbearable,” the source of which might well have been unimpeded sewage flow.<sup>624</sup>

Regardless, these stifling cellars offered little appeal beyond temporary escape from law enforcement.

Many reformer concerns about increasingly packed tenement units involved their lack of ventilation and natural light, deficiencies exacerbated in cellar units. New York’s Society for the Improvement of the Condition of the Poor enumerated several other environmental shortcomings that began at the top with leaky roofs and went to the “damp basements” at the bottom.<sup>625</sup> Others used the underground for a negative standard by which to judge other tenement spaces, for instance criticizing the supposed health benefits of a space called a “yard” because it had “about as much light...as in the average cellar.”<sup>626</sup>

In 1893, twelve-year-old Anzia Yeziarska emigrated with her family from what is now northeast Poland to New York’s Lower East Side. Decades later, Yeziarska’s autobiographically-inspired novel, *Solome of the Tenements*, depicted cellar dwelling as the toughest starting line for social mobility. The protagonist Sonya, who successfully schemes to marry a wealthy American before leaving him to be a professional fashion designer, is described as innately driven such that though “born into the blackest poverty of a Delancey Street basement, yet the drab environment had no power over her.”<sup>627</sup> Yeziarska did not depart entirely from the notion—intimated by Riis and stated by social commentators into the twentieth century—that underground environments, with their literal lowness and their natural accumulation of filth, posed a threat that was at once physical and moral.<sup>628</sup> Yet, with Sonya’s transcendence, she cast their influence as more social obstacle than biological menace.

Nonetheless, warnings and admonishments about keeping young children above ground also remained conventional medical advice at the century’s end. “The further...removed from the basement or

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<sup>624</sup> Riis, *Other Half*, 71-74.

<sup>625</sup> Riis, *Other Half*, 13-14.

<sup>626</sup> Riis, *Other Half*, 179.

<sup>627</sup> Anzia Yeziarska, *Salome of the Tenements* (New York: Boni and Liveright, 1923), 135.

<sup>628</sup> The Country Contributor [anonymous], “The Ideas of a Plain Country Woman,” *Ladies' Home Journal* 24, no. 4 (March 1907): 38, WMA.

the cellar,” the better for a nursery, said *Good Housekeeping*’s “The Family Medicine Chest” series in 1891.<sup>629</sup> The reason was simply that the home’s most elevated rooms had the most fresh air and sunlight, indispensable ingredients of healthy development that most cellars continued to lack. In 1895, a Chicago physician told any family resigned to tenement life that “the upper floors are always the most healthy.” “If there is a baby in the family,” the physician continued, “it is all the more important to avoid the basement, with its foul air, absence of sunlight and nearness to the sewers.”<sup>630</sup> Here, medical advice departed from a science based in instruments and measurements in order to help people make decisions using their own senses to determine a place’s safety. This effectively continued centuries-old processes of labeling certain odors and visible gasses as “miasmatic,” able to directly convey disease upon those who absorbed them.<sup>631</sup> Cellars themselves became a heuristic that health professionals into the early twentieth century, much to the anxiety of some parents who were conscious of health concerns and yet could only afford underground apartments.<sup>632</sup>

Historian of health and environment Linda Nash accounted for how, at the century’s end, a new concept arose around deploying chemical and mechanical products of industry to sanitize a previously unhealthy environment.<sup>633</sup> The concept applied to indoor environments as well, as the environmental and medical historian Gregg Mitman argues. Concerns about personal respiratory health, for example, could be addressed with indoor air purification machinery and ductwork rather than by identifying a more healthful setting in which to breathe.<sup>634</sup> Urban historian Harold Platt further shows that built environments

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<sup>629</sup> A Mother, at Home [anonymous], “The Family Medicine Chest: A Chapter on Children,” *Good Housekeeping* 13, no. 6 (December 1891): 281-283, WMA.

<sup>630</sup> “Feeding the Baby,” *Good Housekeeping* 21, no. 5 (November 1895): 203, WMA.

<sup>631</sup> Alain Corbin, *The Foul and the Fragrant: Odor and the French Social Imagination*, trans. Miriam L. Kochan (Cambridge, MA: Harvard University Press, 1986), 11-21.

<sup>632</sup> Dorothy Lowe, “For the Sake of Her Children,” *Ladies’ Home Journal* 24, no. 3 (February 1907): 10, WMA.

<sup>633</sup> Linda Nash, *Inescapable Ecologies: A History of Environment, Disease, and Knowledge* (Berkeley: University of California Press, 2006), 82-85.

<sup>634</sup> Gregg Mitman, *Breathing Space: How Allergies Shape Our Lives and Landscapes* (Yale University Press, 2007), 167.

often took on positive connotations of health, by which reformers became urban planners who imagined new neighborhoods as organisms that both embodied and engendered moral and physical health.<sup>635</sup>

Suffice to say that in cellars, cement became the leading technology of creating healthy space.

Associating dirty, dark cellars with all the physical and moral ills of slum life made personal social standing central to how people navigated domestic underground spaces and their new technologies in the United States around the turn of the century. Increasingly, home economics and domestic life practices distinguished self-proclaimed progressive Americans from the supposedly backward residents of metropolitan cores, who were largely immigrants and people of color. New basements were viewed as more sanitary and technologically advanced, one piece in what Gabriel Lee identifies as the broad “sterilization” of landscapes via concrete that was central to Progressivism in the early twentieth century.<sup>636</sup> By moving away from the organic decay of wood and produce, well-cemented undergrounds distinguished between the ideal middle-class American family and the peasantry of past and present.<sup>637</sup> Cement created a space in which Americans led, or aimed to lead, lives that transcended lowly filth even as more of their day-to-day living literally descended below the surface.

By 1890, construction professionals insisted that hydraulic cements were essential if cellars were to even belong under a respectable home. A national hardware firm’s guide to building described cellars as full of “spiders, toads and other creeping things” and “the unrelenting enemy of the family physician,” and declared “it would be suicide for one to make it their sleeping room.” Yet, they admitted, the space could be “a convenient, cool... store-room for all sorts of vegetables [and] odds and ends of most everything” if “properly constructed.”<sup>638</sup> Key to mitigate cellar offenses, perhaps saving “the health of

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<sup>635</sup> Harold L. Platt, “From Hygeia to the Garden City,” *Journal of Urban History* 33, no. 5 (July 2007), 756-772.

<sup>636</sup> Lee, “Concrete Dreams,” 81-82.

<sup>637</sup> For more on how modern building materials helped generate notions and realities of class distinction, see Amy Slaton, *Reinforced Concrete and the Modernization of American Building, 1900-1930*, x. And, again, Taylor, *Irish Materialisms*.

<sup>638</sup> National Sheet Metal Roofing Co., *Practical Hints to Builders*, 4<sup>th</sup> ed. (New York: W.J. Pell, 1890).

your entire family,” was a concrete floor. Foundation walls, still brick or stone, needed help from another, related, mineral agent: lime.

Through the 1890s, both building guides and domestic magazines prescribed whitewashing cellar walls or sprinkling dry lime powder, employing the caustic compound as an antibiotic.<sup>639</sup> Harriette Plunkett, the Massachusetts sanitarian author, in her 1885 volume on how women could collaborate with plumbers to prevent illness in their households, endorsed the annual whitewashing of cellar walls. At the same time, Plunkett warned women not to think more frequent washing with water was equally helpful, when in fact that would supply moisture by which molds and other fungi could grow and fruit.<sup>640</sup> In masonry history, lime was a predecessor to hydraulic cement, but it now became a complement that reduced the incidence of fungal and bacterial growth and exterminated cockroaches in cellars. However, lime did not address the root of the problem: moisture in the cellar space that invited and sustained the deplorable biota. Indeed, use of lime in cellars evidenced an incomplete transition of basement environments. Standard cement floors and masonry walls sealed cellars against the worst incursions of rats or sewage, but elements in the air remained too unregulated for most cellars to be deemed comfortable.

#### Domestic Utilities and Domestic Help in the Underground

As with the excavation of cellars, their modernization via cement occurred especially in climates with winter weather, where residents sought to accommodate modern central heating technologies. These included a central hot air furnace and often a central water heater that replaced stoves distributed

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<sup>639</sup> *Practical Hints for Builders*, 23; Martha Newton, “House-Cleaning: To Be Done Decently And In Order,” *Good Housekeeping*; 10, no. 13 (April 26, 1890): 292-293, WMA; M.D. Sterling, “Hygienic Housekeeping: How to Avoid Doctors' Bills,” *Good Housekeeping* 20, no. 2 (February 1895): 55-56, WMA; Annabel Lee, “Domestic Economy: In Twelve Monthly Chapters,” *Good Housekeeping* 22, no. 4 (April 1896): 149-152, WMA; Hester M. Poole, “The Best Way: In Doing All Manner of Things About the House,” *Good Housekeeping* 29, no. 1 (July 1899): 26-29, WMA.

<sup>640</sup> Mrs. H.M. [Harriette Merrick] Plunkett, *Women, Plumbers, and Doctors; or, Household Sanitation* (New York: D. Appleton and Company, 1885), 40.

throughout a house.<sup>641</sup> Central heating equipment justified excavation even more than foundation walls, which could be set into narrow trenches for cost saving. A furnace, of course, needed to remain accessible to whomever did the work of tending its fire, removing its ashes, and adding water to humidify the hot air that could otherwise suck moisture from both the woodwork and the occupants' bodies to a damaging degree.

The whole system of a cement-sealed full basement with heating equipment became standard for new home construction in the many rapidly developing urban areas throughout the Northeast and North Central United States. This distinguished domestic architecture internationally as well as regionally. In 1888, an English contributor told *Good Housekeeping*, "We have no such basement as that familiar to Americans."<sup>642</sup> Instead, a desirable home in England might have discrete cellar spaces including coal storage under the kitchen and a brick-lined wine vault adjacent the dining room. Some older English homes may have been retrofitted with central furnaces, but no doubt many still had their original room-by-room stove system.

With steadily increasing application of cement, American cellars were more than a controlled environment themselves. They were also an operational center for controlling environments throughout the house, the improved exclusion of water, dirt, and organisms below translating to warmer and cleaner spaces above. The upstairs-downstairs environmental connections numbered even more. Underground furnaces created warm air that rose, initiating the circulation patterns that experts had previously identified as necessary to a healthy cellar.<sup>643</sup> In their efforts to push and pull all Americans into a higher standard of living, Progressive housing reformers wanted to designate all cellars for such utility technologies rather than as spaces for socializing or sleeping. Riis, for example, praised one working-

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<sup>641</sup> N. D. Wright, "House Heating, Home Lighting and Cooking: Heating," *Good Housekeeping* 10, no. 8 (February 15, 1890): 169-171, WMA.

<sup>642</sup> Frances B. James, "Kitchen Offices in English Country Houses," *Good Housekeeping* 7, no. 5 (July 7, 1888): 109, WMA.

<sup>643</sup> *Practical Hints to Builders*, 22.

class housing complex where the superintendent reported “little trouble with disorderly tenants.” The basement spaces throughout the complex had no bedrooms or taverns. They housed “coal lifts, ash-chutes, [and] common laundries.”<sup>644</sup>

As cemented cellars and heating became standard at least in middle-class homes, tension began to develop within and among visions of what cement’s environmental regulation would achieve and for whom. One source of tension concerned the fact that new technologies of cleaning and climate control were fueled by astonishingly dirty coal. Thomas Andrews, the noted environmental historian of coal mining, writes that the black dust was so present during extraction as to cover laborers faces, muting physical differences and thereby contributing to worker solidarity across ethnic and racial identities.<sup>645</sup> Self-consciously middle-class Americans certainly would not invite such a humbling and homogenizing material into their homes, where its corruption of underground environments might be recreated even in small ways.

Yet, as many other environmental historians have also chronicled, modern peoples’ partnership with the immense energy of coal constituted a democratizing and industrializing force, inseparable from the history of middle-class America.<sup>646</sup> Domestic coal use had developed in mid-nineteenth century American cities thanks to a combination of abundant deposits and investment in transportation networks.<sup>647</sup> Americans carried practices of home coal use with them across the continent, even to the wood-laden Pacific Northwest.<sup>648</sup> Therefore, intimately connected to this problematic material, many Americans welcomed the environmental checks that cement provided around coal storage. At the end of the century, cement in basements from Boston to Seattle was keeping soil and water out of coal piles and

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<sup>644</sup> Riis, *Other Half*, 198.

<sup>645</sup> Thomas G. Andrews, *Killing for Coal* (Cambridge, MA: Harvard University Press, 2008).

<sup>646</sup> In addition to Andrews, *Killing for Coal*, see Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (London: Verso, 2011); LeCain, *The Matter of History*, 322-323.

<sup>647</sup> Christopher F. Jones, “A Landscape of Energy Abundance: Anthracite Coal Canals and the Roots of American Fossil Fuel Dependence, 1820–1860,” *Environmental History* 15, no. 3 (July 2010): 449–484.

<sup>648</sup> Frederick Bracher, “How It Was Then: The Pacific Northwest in the Twenties,” *Oregon Historical Quarterly* 85, no. 1 (Spring 1984): 40.

making floors from which the carbon-rich dust could easily be swept for disposal. As chapter four will address, across much of the northern tier, bulky and dusty coal dominated for decades, even after Americans in some regions turned to piped-in natural gas and fuel oil, often stored in basement tanks, to heat their homes. Coal-fired furnaces and coal storage were therefore the context in which many homeowners conceived of basement space. Coal helped popularly define both the ideal volume and the ideal environmental qualities of the domestic underground.

Through the century's end, many of the people frequenting cellars to toss a scoop of coal into the furnace belly were neither homeowners nor their kin but rather their hired help. In some cases, they slept, like the bemoaned tenement dwellers, in basement bedrooms, better bounded though these may have been under stately manors.<sup>649</sup> The grandest basements featured not only sleeping quarters but also kitchens, pantries, and laundry areas.<sup>650</sup> The developing work of domestics was enmeshed with cement use and new household appliances, all together in the cellar.<sup>651</sup> As a leading chronicler of domestic environments, historian Clifford E. Clark notes that increased use of basements by service workers, which included not only domestics but also the coal delivery man, led to new designs for basement access in the middle-class home at the century's end. This frequently meant a side door with stairs straight into the basement, and often up to the kitchen as well.<sup>652</sup>

As Clark noted, in 1870, half of the wage-earning women in the U.S. were domestic servants. However, that overflowing labor pool evaporated, first slowly as states enacted and enforced compulsory education laws aimed at assimilating immigrant children and then rapidly when department stores and

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<sup>649</sup> For more perspective on the intense and contentious definition of class by domestic architecture and home environment in this period, see Andrews, *Killing for Coal*, 209-211.

<sup>650</sup> Servant activity under homes is documented in many ways, including in historic preservation listings. For an example of architectural drawings specifying this use, see the plans for the Cincinnati mansion of attorney George M. Hord in *Hinkle & Co.'s New Book on Building* (Cincinnati: Hinkle & Co., 1869), 79.

<sup>651</sup> For a few other early examples of this spatial grouping, see: *Hinkle & Co.'s New Book on Building*, 74, 83; George E. Woodward, *Woodward's Cottages and Farm Houses* (New York: The American News Company, 1867), 88-89.

<sup>652</sup> Clark, *The American Family Home*, 167.

some factories began hiring young women at the century's end.<sup>653</sup> Nonetheless, the recently widespread employment of domestics and the continued aspiration by many to a life with hired help shaped popular uses and conceptions of the cemented cellar. Cellars became spaces in which affluent homeowners could relegate what they did not want to consistently encounter upstairs, a list that ranged from dusty coal to the servants themselves to the harsh smells emanating from the era's standard kitchen and laundry activities.<sup>654</sup>

A second tension emerged from the fact that dryer and cleaner basement supported visions of efficient modern technology that cut down on domestic labor. This might have freed the home's occupants, and even the servants, from drudgery while also giving them welcome separation from the discomforts and pestilence of exterior environments. In truth, however, the cemented cellar was an example of what historian Ruth Schwartz Cowan has demonstrated for a range of past household technologies. Sold on the premise of assisting women and minimizing their labor, the technologies in fact created extra duties for the modern housewife, in part by simultaneously raising standards of cleanliness.<sup>655</sup>

As much as they were convenient areas for completing chores and for letting children play, basements contributed to such mounting expectations. Weather was no excuse for putting off laundry with a basement. Untidiness was even less acceptable in the home's public areas when messier items and activities could be located belowground. Moreover, the basement square footage itself could and should be swept, thanks to the smooth and solid cement floor. And new central furnaces and laundry stoves still required incessant labor to stoke the fire with fresh coal and remove the resultant ash. Though some

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<sup>653</sup> Oriana Bandiera, Myra Mohnen, Imran Rasul, Martina Viarengo, "Nation-Building through Compulsory Schooling during the Age of Mass Migration," *The Economic Journal* 129, no. 617 (January 2019): 62–109.

<sup>654</sup> Melanie A. Kiechle, *Smell Detectives: An Olfactory History of Nineteenth-Century Urban America* (Seattle: University of Washington Press, 2017), 92-93.

<sup>655</sup> Cowan, *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave*.

middle-class Americans initially assigned this work to hired help, the homemaking wife quickly became responsible for working in the basement.

### Achieving Cleanliness Underground

As historian of medicine Nancy Tomes has evidenced, at the turn of the century many American women had grown up hearing that cellars were a male space. Only in the 1880s had domestic advisors begun urging women to take responsibility for underground upkeep. This meant braving cellars despite how “weird, forbidding, and uncanny” those “dark, damp spaces” often were.<sup>656</sup> But in those same years, cellars were decreasingly defined by those environmental qualities. Concrete floors and cemented walls alleviated some discomforts and facilitated the new appliances that put a refined gloss on women’s emerging list of duties. These spaces did not inherently impinge on their social standing. In fact, the most cemented cellars could preserve a clean respectability even as women increasingly went belowground to complete household tasks.

Harriet Plunkett was one of the domestic advisors interested in teaching women what their respective domestic subterraneans could and should be, thanks to collaboration with modern technologies including cement. Plunkett’s ample advice on maintaining a clean cellar spoke not only to the tangible comforts that cemented cellars allowed but also to the psychological discomforts that they assuaged. Sanitarians had articulated and promoted a popular understanding of buildings as containers that, like a bell jar, were open on the bottom and therefore constantly accumulating whatever foul and threatening gases came in through the ground.<sup>657</sup> To Plunkett in the 1880s as to Griscom decades earlier, these emissions from below were a significant reason to adequately ventilate the upper stories of a home. Yet by the 1880s, Plunkett recognized concrete cellar floors, especially if topped with a coat of asphalt, as a

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<sup>656</sup> Nancy J. Tomes, *The Gospel of Germs: Men, Women, and the Microbe in American Life* (Harvard University Press, 1998), 65.

<sup>657</sup> The bell jar metaphor had been popular among sanitarians for describing both structures and the physiological of people’s lungs themselves. See Griscom, *Uses and Abuses of Air*, 19-20.

prophylactic. Equating this combination with the rubber footwear described in chapter three, she called it “an impervious overshoe” that was the best way of keeping germs from below out of one’s house.<sup>658</sup> In combination with “solid foundation-walls,” meaning thicker and more cohesive than the cheapest offerings from a builder, Plunkett trusted that concrete floors made cellars places where women could safely perform household labor.<sup>659</sup>

The messy and wet process of clothes washing was an obvious choice to move into a lower level.<sup>660</sup> There, a concrete floor could channel and drain unruly water, and the relative dryness and warmth was helpful for doing laundry during the months when wringing and hanging clothes outside was unpleasant or unfeasible. The space, even if still prone to a little dust accumulation, was far more helpful to the goal of clean clothes than earlier laundry spaces of yards or alleyways that were completely open to counterproductive filth.<sup>661</sup> Basement space also offered a receptacle for the profusion of laundry equipment that manufacturers were beginning to market for modern homemakers: various combinations of tubs and wringers, boilers, ironing boards, chests of slide-out drying racks with an accompanying stove unit, and more.

As mentioned, laundry activity was a source of unwanted odors in a time when soaps created cleaner appearance but did not themselves smell “clean” in the ways Spring Greeney, historian of domestic environments, shows that chemical companies later engineered.<sup>662</sup> In chronicling smells and smelling within nineteenth-century American cities, Melanie Kiechle finds that one important task of women’s home upkeep was odor management for both health and comfort.<sup>663</sup> When women sequestered

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<sup>658</sup> Plunkett, *Women, Plumbers, and Doctors*, 27.

<sup>659</sup> Plunkett, 29.

<sup>660</sup> For an example of the laundry room in basement floor plans at the beginning of the twentieth century, see George W. Watson, “A New England Colonial House for \$4600,” *Ladies' Home Journal* 23, no. 4 (March 1906): 33, WMA.

<sup>661</sup> Spring Greeney, “What Cleanliness Smells Like: An Environmental History of Doing the Wash, 1842–1996” (PhD Diss., University of Wisconsin-Madison, 2019), 124-133.

<sup>662</sup> Greeney, “What Cleanliness Smells Like,” 210-256.

<sup>663</sup> For more on smell sequestration in domestic architecture and odor management as women’s work, see Kiechle, *Smell Detectives*, 78-81, 94, 183-185.

odoriferous household activities underground, basements preserved a home's first-floor spaces where visitors were received and thereby made those spaces high class according to an odor-based definition.<sup>664</sup> Cemented basements' ability to host some unpleasant smells complemented their ability to keep even more noxious odors, like sewage, from entering the home at all.

Ordinary basement floor plans for new homes began including wash basins, sometimes as the only built-in element of that level. Outpacing the standardization of basement lighting, women noted that these tubs were most useful when positioned near small windows that provided daylight from above.<sup>665</sup> These windows were perhaps easier to build and lasted longer with hydraulic cement, which also facilitated more widespread construction of window wells that greatly increased admission of light. Soon, however, most urban and suburban basements were electrified. This allowed for not only artificial light but new electric clothes washers, which when placed in a walled-off space earned that area the immediately gendered designation of "laundry room."<sup>666</sup> Even as washing machines, whether electric or still hand-operated, became common, self-contained drying machines remained unrealized for decades. The warm air emanating from the new heating equipment located in basements afforded something of a substitute.

Greeney's account of laundry transitions also adds perspective on the extent to which white middle-class women chose to labor in the modern basement and their motivations for doing so. From the 1890s to the 1910s, in Greeney's words, "commercial alternatives like steam laundries and paid help proved viable options for white women of means."<sup>667</sup> Middle-class and affluent white women first

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<sup>664</sup> For more on how practices of modern domestic architecture that entailed partitioning interior spaces developed in Europe at the intersection of smell and class, see Corbin, *The Foul and the Fragrant*, 161-175.

<sup>665</sup> "Discoveries: By Our Observers and Experimenters," *Good Housekeeping* 36, no. 6 (June 1903): 533, WMA.

<sup>666</sup> For an example of a separate laundry room as a component of the basement floor plan in even modest homes, see M.L. Keith, "The Well Designed Small House," *Fruit, Garden and Home* 2, no. 1 (September 1923): 22, WMA.

<sup>667</sup> Greeney, "What Cleanliness Smells Like," 124.

preferred to send laundry out as a solution to the problem created when, as noted earlier, unmarried white girls and women chose school or other jobs over domestic work. As Greeney points out, though this problem was often characterized as an absolute labor shortage, domestic help remained available for hire. The labor pool's demographics simply shifted to predominately Black, Asian, and Mexican women. Sending out laundry often meant directly engaging the same populations. Despite popular attitudes among white Americans that non-white women were fit for domestic work and qualified for little else, those women were not the help that middle-class white Americans wanted. Ironically, as some American home managers became self-conscious about relegating servants to belowground bedrooms and toilets, others chose to do their own laundry in the basement.<sup>668</sup> In 1909, some were aided by a new Maytag washer dubbed the "Hired Girl."<sup>669</sup> Cement had controlled the environment enough to both keep these expensive machines in good condition and make women more comfortable underground.

By that time, in several cities cement basements had become part of a broader campaign, the aim of which was to prevent disease outbreaks. Historian of concrete Gabriel Lee explains how that campaign took shape quickly in response to an outbreak of plague in San Francisco as the city began rebuilding from the 1906 earthquake. In early 1908, Dr. Rupert Blue of the U.S. Marine Hospital Service began leading an effort to render San Francisco, as he put it, "one block of concrete throughout" such that "the gateway to the Orient [would be] closed to the plague." The insinuation that Chinese immigrants were to blame was at odds with the fact that local officials wanted more concrete because they deemed successful the previous efforts to thoroughly cement Chinatown, which was nearly untouched by the post-earthquake epidemic.<sup>670</sup> Regardless, the new mission led by Blue translated into new municipal ordinances that

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<sup>668</sup> For prescriptions against making servants use the basement service toilet and assuming they should sleep on the top floor rather than below, see Charles E. White, "The Servant in the Little House," *Ladies' Home Journal* 30, no. 11 (1913): 11, 54, WMA, and Estelle H. Ries, "Getting the Most from Your Bathroom," *Fruit, Garden and Home* 2, no. 6 (1924): 12, WMA. Admonishment of those who gave underground sleeping quarters to servants is also a topic in Plunkett, *Women, Plumbers, and Doctors*, 43.

<sup>669</sup> Greeney, 134.

<sup>670</sup> [this is from Lee, right?] 105

named basement floors among many types of ground-level surfaces that needed to be replaced by sanitary concrete. Lee estimates that over the ensuing years San Franciscans put down 6,433,100 square feet of new concrete surfaces, “over 111 football fields.” Roughly two-thirds went into private structures, including in the basements of homes.<sup>671</sup> Though in San Francisco this cementing was all publicly characterized as the typical rat-proofing project, here with plague fears at its heart, the other benefits of concrete in the domestic subterranean were coming well into focus.

### The Kids Are Alright in the Basement

Many middle-class women descending into the basement to wash clothes were also mothers. As historian of motherhood Jodi Vandenberg-Daves has documented, the proliferation of written maternal advice in nineteenth-century journals strengthened and updated an articulation of mothers’ duties that had been developing since the country’s inception. Broadly distributed periodicals instructed readers, primarily white and middle-class women, in the proper practices of raising children. The popular advice assigned ultimate responsibility for children’s character to their mothers, which made many mothers reluctant to be apart from their children.<sup>672</sup> Successful modern motherhood entailed nearly continuous supervision.

While continuous oversight of children was plainly impracticable for many women including those who worked outside the home, the ideal might have seemed attainable to the growing number of middle-class homemakers. The modern basement supported notions that mother’s constant supervision was possible, because a space that was clean and comfortable enough for mom was likely satisfactory for the kids. When mothers went downstairs to do laundry, they brought young children with them. A simple basement play space, perhaps just an empty spot on the floor that could host activities with blocks or

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<sup>671</sup> Lee, “Concrete Dreams,” 106:

<sup>672</sup> Jodi Vandenberg-Daves, *Modern Motherhood: An American History* (New Brunswick, NJ: Rutgers University Press, 2014), 2, 173-177.

dolls, was only steps away or just around the corner from mother's laundry unit.<sup>673</sup> Fully excavated basements tended to have enough space to spread out activities—meaning kids were less endangered by hot irons or boiling water—and also few walls and doors that might block sound or vision within the space. While a mother did the work of washing clothes, her children were not directly under foot, but they were within talking distance and only ever a few steps out of sight.

Mothers' decisions that basements were a safe space for children effectively expanded the living space within modern homes. This was especially true in the privacy of single-family homes, where, for instance, a full basement doubled the livable square footage of a one-story bungalow. Though some Americans imagined communal child-rearing in basements under multi-unit housing, in the 1920s basement play became a much more individualized practice that took hold most coherently in America's proliferating neighborhoods of such private, single-family homes.<sup>674</sup> Notions of what qualified as being under mother's supervision loosened somewhat in tandem with growing trust in these underground spaces. Children in a basement recreation room seemed enough in mother's care whether she was interacting with them, doing laundry around the corner, or reading a domestic advice magazine upstairs.

By 1930, domestic magazines told mothers explicitly that they should designate an independent play space for children within the house. The child-friendly basement as an asset to mothering preceded and then developed alongside this new tenet of youth development, postulated by childhood psychologists and interpreted through popular publications. In 1930, Gladys Shultz gave one interpretation in her *Better Homes and Gardens* article, "What You Can Do to Give Your Children the Right Start in Life."<sup>675</sup> In essence, the plan was to give a toddler enough space to become comfortable in individual activity. By the 1930s, many parents believed that relatively undirected basement play would help children come to

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<sup>673</sup> "A Winter Playroom," *Good Housekeeping* 24, no. 2 (February 1897): 75, WMA.

<sup>674</sup> For one example of imagined communal basement play, see Sarah Louise Arnold, "The Ideal Suburban Home of the Near Future," *Good Housekeeping* 55, no. 4 (October 1912): 501-502, WMA.

<sup>675</sup> Gladys Denny Shultz, "What You Can Do to Give Your Children the Right Start in Life," *Better Homes and Gardens* 8, no. 8 (April 1930): 127, WMA.

“know their place” in the family and in society.<sup>676</sup> Basement play gave many young people more individual play experiences and taught them the literal and metaphorical boundaries within which they were free to do as they pleased. This was cast as prerequisite to parents assigning each child age-appropriate responsibilities for household cleaning and tidying that they could accomplish on their own. An image accompanying one article showed a boy playing with an erector set by himself. The caption read, “Rule 1 in teaching the child to find successful expression in work is to leave him alone to develop his own resources in work or in play.”<sup>677</sup> The path that avoided failure was one facilitated by a home with separate living spaces, and the comfortable basement offered wonderful separation.

Some Americans explicitly characterized the modern home basement as mother’s helpmeet in parenting. Another *Better Homes and Gardens* contributor, Mabel Stegner, went so far as to say a basement could “rescue” a mother and her kids.<sup>678</sup> The rescue described was from the dullness or restlessness children might otherwise experience on a rainy day, had they no basement in which to recreate. She gave an account of an “additional living-room,” forged from what were once simple cellars and “dark, dusty, cobwebby basements.” Stegner cast this as the historical “progress of the below-ground portion of the house.” To her, the modern basement ranked as a significant step toward better experiences of motherhood and childhood.

Further into the twentieth century, many mothers developed concerns regarding what historian Pamela Riney-Kehrberg calls “the dangers of the unstructured out-of-doors.” Mid-century parents increasingly welcomed children to play inside “even if they were, potentially, more often under foot,” as Riney-Kehrberg put it.<sup>679</sup> But she also recognized that the problem of children under foot was diminished

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<sup>676</sup> Dora Smith Conover, “Play Room,” *Chatelaine* (October 1933): 26, 65, WMA.

<sup>677</sup> Gladys Denny Shultz, “Fitting the Child for His Task,” *Better Homes and Gardens* 8, no. 7 (March 1930): 42, 83, WMA.

<sup>678</sup> Mabel J. Stegner, “The Basement to the Rescue,” *Better Homes and Gardens* 10, no. 2 (October 1931): 16, 102, WMA.

<sup>679</sup> Pamela Riney-Kehrberg, *The Nature of Childhood: An Environmental History of Growing Up in America Since 1865* (Lawrence: University Press of Kansas, 2014), 162.

in the many middle-class homes that had a full basement. As such, twentieth-century parents' concerns about outdoor threats reinforced notions of basement play's safety that had been spreading since the turn of the century.

Not Quite an Indoor Space: Vestigial Cellar Cultures & Making Messes

As children learned to play in the basement, they and their parents had to establish what kind of play space basements were. Throughout the emergence of underground living rooms, most basements remained ambiguous as indoor or outdoor spaces. The dryness and relative absence of dirt were indoor qualities, but the spaces lacked rugs, drapes, china cabinets, and anything else that could be soiled or broken. This left open the possibility of rambunctious play and messy activities. One mother advertised in 1897 that she used an oil space heater during winter specifically to facilitate what were typically outdoor activities. Her children rode bikes and even played in a sand pile she had shoveled into their basement.<sup>680</sup> In 1911, a mother wondered whether guinea pigs and other such pets, best kept in outdoor pens, were also appropriately housed in a basement.<sup>681</sup> In the 1920s, a balance between outdoor and indoor was both better defined and commercialized. One playground equipment company adapted swings and climbing structures for basement use.<sup>682</sup>

In the early twentieth century, many American homeowners experimented with the indoor/outdoor balance of cemented basements as it pertained to a variety of realms beyond children's play. Notably, the fully cemented cellar facilitated new gardening habits. In 1912, a Minnesota woman wrote to *Good Housekeeping* about the fungiculture that she, her husband, and some acquaintances of theirs practiced.<sup>683</sup> By covering their basement's floor with a mushroom-friendly substrate of cured horse

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<sup>680</sup> "A Winter Playroom," *Good Housekeeping* 24, no. 2 (February 1897): 75, WMA.

<sup>681</sup> Charlotte Reeve Conover, "The Secret Society of Mothers: In Which a Mother of Eight Children Chats with Other Mothers," *Ladies' Home Journal* 28, no. 7 (April 1, 1911): 28, WMA.

<sup>682</sup> "Advertisements," *Children: The Parents' Magazine* 11, no. 7 (July 1927): 46, WMA.

<sup>683</sup> "Discoveries," *Good Housekeeping Magazine* 55, no. 4 (October 1912): 582, WMA.

manure and supplementing their furnace's radiant heat with a small oil stove, they and the cement had co-created an environment that yielded 60 pounds of produce every few months. The cement barrier excluded "cut-worms, weeds, pocket-gophers, and the other ills that vegetables are heir to." She used both "cellar" and "cement basement" for her underground space, an interchangeability that fit her not-quite-indoor use.

The sealed basement's frost-free conditions also lent themselves to storing a garden hose, which could be pulled through the basement wall via a small, intentional compromise of the space's envelope.<sup>684</sup> A garden could also directly benefit from the new underground environment by building an abutting greenhouse, accessed from inside and heated with a pipe from the furnace. In 1923, readers of *Fruit, Garden and Home* were encouraged to imagine owning such a greenhouse, "A tiny garden of Eden" that produced "for profit or for pleasure."<sup>685</sup> It promised to keep plants healthy through winter's worst.

The admission that such gardens were at least as much novelty as a source of income reveals an important context of the relationship between modern basement, coated by industrial cement, and a non-industrial natural world with which urban Americans were losing touch. Several scholars of environmental thought have shown that in the first years of the century, native-born US citizens promoted gardening as part of an Americanizing curriculum for school children.<sup>686</sup> Their goals diverged from traditional cellar vegetable storage. These hobby gardens were not about producing one's own food, a practice associated with unadmirable, impoverished immigrants. Instead, seasonal access to a little fresh backyard produce, was proof of status relative to the tired or decaying produce immigrant families reportedly ate in crowded urban cores. In this context, an obvious opportunity of fully cemented

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<sup>684</sup> "Buying a Garden Hose," *Fruit, Garden and Home* 1, no. 14 (August 1923): 28, WMA.

<sup>685</sup> Dale R. Van Horn, "A Small Greenhouse Will Pay," *Fruit, Garden and Home* 2, no. 1 (September 1923): 24, WMA.

<sup>686</sup> Robin G. Schulze, "Robin G. Schulze on 'Prize Plants,'" *Environmental History* 8, no. 3 (July 2003): 474-78; Adam Rome, "Nature Wars, Culture Wars: Immigration and Environmental Reform in the Progressive Era," *Environmental History* 13, no. 3 (July 2008): 432-453; Stephan F. Brumberg, *Going to America, Going to School: The Jewish Immigrant Public School Encounter in Turn-of-the-Century New York City* (New York: Praeger, 1986), 94.

basements went unrealized, though it was recognized. Domestic advice writers noted that the climate and pest control allowed for keeping vegetables fresh.<sup>687</sup> Yet the modern basement was decreasingly used for food.

### Standardized Concrete and Mainstreamed Basement Living

Changes within the cement industry led to a more thorough cultural transformation of the American domestic subterranean. In the early twentieth century, cement makers had become conspicuously more organized. Trade organizations consolidated and executives strategized to market Portland cement as a standardized, reliable product. Through annual meetings and regular communication, the industry developed means of selling its products that were more effective than the previous combination of syndicated how-to columns and conversations among contractors. Marketing first included informational publications, generated by powerful individual firms like those fittingly named Atlas or Universal or Hercules.

In 1916, the Portland Cement Association (PCA), an East Coast trade organization that had gradually become a national affair since its 1902 founding, opened offices across the country and moved its headquarters to Chicago.<sup>688</sup> PCA publications touted Portland cement as the key to affordable, moldable, enduring, and sanitary concrete, an all-around solution in a slew of construction applications.<sup>689</sup> PCA helped connect the industry with home builders and building material suppliers in major metropolitan areas, who were themselves just beginning to consolidate.<sup>690</sup> PCA continued advertising to

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<sup>687</sup> Clarence E. Baker, "Storage for Fruit and Vegetables," *Better Homes and Gardens* 3, no.1 (September 1924): 28-29, WMA.

<sup>688</sup> Lesley, *History of the Portland Cement Industry in the United States, 196-197*, 227-230.

<sup>689</sup> Portland Cement Association, "Catalog of Books, Periodicals and Pamphlets in the Library of the Portland Cement Association," June 1918, available via Hathi Trust at [https://hdl.handle.net/2027/uc1.\\$b116017](https://hdl.handle.net/2027/uc1.$b116017), accessed February 26, 2025.

<sup>690</sup> Barry Checkoway, "Large Builders, Federal Housing Programs, and Postwar Suburbanization," in Robert W. Lake, ed., *Readings in Urban Analysis: Perspectives on Urban Form and Structure* (Routledge, 1983), 173-196.

property owners themselves, especially in rural areas, but they increasingly promoted cement directly to the construction firms. Those firms not only consolidated but added new materials and new tools that helped precipitate overhauls to labor and management structure. Cement use quickly transformed from a slapdash realm of unskilled laborers dumping dusty bags and pushing wheelbarrows into a set of practices that relied on novel and expensive equipment. Businesses pivoting toward concrete included well-established lumberyards, paving companies, and distributors of other building materials—all with capital and revenue to invest in equipment.

Among the new equipment was an array of mobile concrete mixing apparatuses, developed by tinkerers in the U.S. and Europe from approximately 1900 to 1930.<sup>691</sup> One-bag cement mixers on trailer axles could be pulled to new neighborhoods by truck and winched into excavation after excavation to pour basement floors in factory-style construction. Newer engine-powered trucks featured constantly churning drums that mixed cement and aggregates on the way to each site, where large batches of wet concrete flowed down a sluice into waiting forms. In a dovetailing development, by the 1930s builders could purchase agile Caterpillar tractors that reduced costs of excavation, grading, and back-filling.<sup>692</sup>

Cement industry marketing benefited from the fact that by then nearly all the cement U.S. manufacturers produced was the synthetic Portland type. Cement had become a highly standardized material produced with recipes that varied only slightly, and intentionally, to yield specific results in color, setting time, or maximum compressive strength.<sup>693</sup> Standardization of products and consolidation of trade associations occurred among manufacturers in other nations, including Germany, Austria, and England. The ability of one voice to speak for all cement makers in a nation allowed the industry to promote not

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<sup>691</sup> Richard Bodlaender, “Mortar-Mixer,” US Patent 751,898, filed May 23, 1903, and issued February 9, 1904.

<sup>692</sup> American Builder, *Big-Value Homes* (New York: Simmons-Boardman Publishing Corp., 1938), 24-25.

<sup>693</sup> For an example of a specific formulation of portland cement, see “California Quick Hardening Concrete,” *Rock Products* (March 6, 1926): 46, and “Winter Concrete” (November 9, 1926), Universal Atlas Cement Company, both in Group 1, Series B, folder “Publications, Lumnite, 1923-26, 1932, 1947-48,” collections of the National Canal Museum, Easton, PA; Edward D. Boyer, *The Manufacture of Portland Cement* (Atlas Portland Cement Company, 1930), viewed at the National Canal Museum.

only their products but also general standards for concrete. For example, advice on cement use had long mentioned the quality of sand used as a major concern. Now, formal testing and reports codified a role for sand in the complex environmental systems that constituted modern construction. One industry engineer reported in 1914 that tests had “brought out prominently the importance of paying attention to the quality of sand, its mineral character, its coarseness or fineness, and its freedom from extraneous matter.”<sup>694</sup> The more angular the sand and the freer of “extraneous matter” like soil, the better cement would bind to it. Clearly articulated standards for cement and concrete made basement construction increasingly uniform.

As builders put the cement industry’s advice into practice, the result was generally more competent and more cohesive concrete structures at lower cost. In the case of home basements, that meant not only a foundation that would better hold up under the weight atop it but also a set of floor and wall surfaces that would better exclude all those unwanted elements that invaded cellars past. Poured concrete was a revelation for building concrete walls, which had previously been achieved by placing layer upon layer. Concrete masons had formerly spread the material inside long and narrow lumber forms to advance upwards only inches at a time. A layer that was timed improperly or not packed well enough could leave a perforated horizontal seam where it contacted the layer below. By 1930, a revolutionary material was suddenly widely available. Plywood, a technology largely adopted from Germany and with roots in aircraft production, could be purchased in four-foot by eight-foot sheets that, when used as forms, diminished the risk of unwanted pores while also reducing the cost of concrete foundations.<sup>695</sup>

With bulk application of cement now more affordable, some developers were inclined to try building entire homes of concrete.<sup>696</sup> For decades, engineers and entrepreneurs had fantasized about how

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<sup>694</sup> Riverside Portland Cement Company, *Good Concrete: A Manual for the Rational use of Portland Cement* (Los Angeles: Riverside Portland Cement Company, 1914), 180, viewed at The Huntington Library, Pasadena, CA.

<sup>695</sup> Much of this history of plywood is found in Ray Sorensen, “Dry Film Gluing in Plywood Manufacture,” *Journal of Fluids Engineering* 56, no. 1 (January 1934): 37–46. In some concrete walls, lasting evidence of a plywood form exists in the lenticular shape where a sheet’s knot was patched.

<sup>696</sup> Poured concrete home, “highly fire- and termite-resistant, and combines good insulating value with low maintenance and repair cost” in Orvis Paxton, “They Poured It!: By Using a New Construction

fully concrete homes could bring efficient mass production practices to the home construction industry. Now, their appeal came as much from what cement could keep out, including bugs and air that was too hot or too cold.<sup>697</sup> While entirely concrete homes mostly remained a fantasy, entirely concrete basements became reality for a steadily growing group of Americans. In the late 1920s, those neatly bounded subterranean environments contributed to a new vision of the modern home.

“A Story in Your Basement,” a 1929 *Ladies' Home Journal* article by Roy Whitfield Wright, demonstrated the nascent popularity of aspirational basement life. Wright took readers along on a model home tour, bringing them down a set of stairs into “one of the most homelike and comfortable rooms imaginable.” The space must have begun with a concrete shell, though that element was invisible in Wright’s account. The walls were covered in knotty pine paneling. Multi-hued slate flagstones paved the floor. A log flamed steadily within the brickwork of a corner fireplace. Wright had an epiphany: “this beautiful room is part of a modern basement!” The builder, Wright’s tour guide, claimed “this basement ‘sold the house’ [to] a family of father, mother and six children.” The mother’s interest in the house had escalated when she imagined her children playing below ground, safely in the home but out of the tidy upstairs spaces. Her homemaking colleagues had recognized that value of basements for decades. More novel was this woman’s vision that the room would, in her words, “grow up” with the family.<sup>698</sup> The basement’s comfort was malleable over time, such that the space could “run the gamut of usefulness from a nursery to a cool peaceful place for grandmother to sew on a hot summer’s day.” In between, the family basement room could be a gymnasium, a stage for theatrical productions, and a party room where youth would pop corn over the fire and dance to the radio.<sup>699</sup>

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Method, This New Orleans Home of Mr. and Mrs. J. E. Blevins Has Been Built for \$10,000,” *Better Homes and Gardens* 14, no. 10 (June 1936): 28-29, 91-92, WMA.

<sup>697</sup> See Lee, “Edison’s ‘Concrete House,’” in “Concrete Dreams,” *Big-Value Homes*, 148.

<sup>698</sup> See the Pittsburgh-area basement plan in a “home that grows,” with labels Laundry, Play Room, Furnace Room, Coal Bin and a below-ground Garage in *Big-Value Homes*, 145.

<sup>699</sup> Roy Whitfield Wright, “A Story in Your Basement,” *Ladies' Home Journal* 46, no. 4 (April 1929): 124, 126, WMA.

Wright's use of the term "modern basement" was significant. A finished basement—not only fully cemented but also with layers of selected textures and colors covering the cold, gray concrete and concealing most plumbing, ductwork, and wiring—was evidence to many architectural and domestic pundits of a rupture from the old times. This rupture was not only aesthetic. The potential to change the basement's use as well as its décor definitively freed middle-class Americans from the narrow social circumscriptions that typified domestic space in Victorian culture. As Wright put it, in contrast to the malleable basement, "living rooms must remain living rooms, and dining rooms can change very little." Basement living space was therefore a striking innovation of classy utility. Builders and architects declared that the construction of intentional basement living space was, as one put it, "a practical and logical development in home building." They began to promote construction of full concrete substructures, even for buyers who could not yet afford all "the finishing and furnishing of a modern basement." Wright concluded that if new homeowners paid upfront for quality concrete underpinning, then "the fixings can come later."

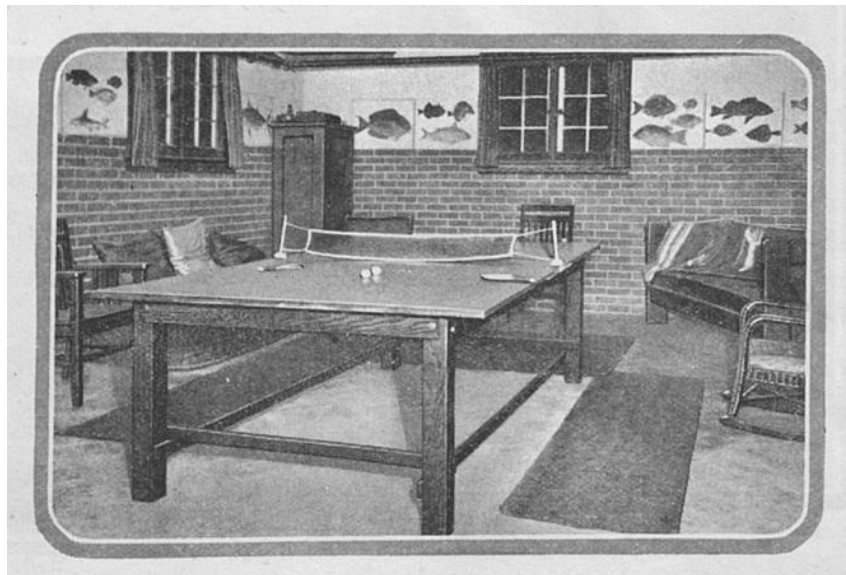


Figure 4.2. A model modern basement complete with table tennis equipment, published as an illustration Ethel Wan-Ressel's 1929 *Better Homes and Gardens* article, "The Basement Beautified."

### Conclusion

After decades of piecemeal cementing, new systems of home heating, and much negotiation by mothers, the modern basement had fully arrived, and the cellar was retreating into the past. Good riddance, Ethel Wan-Ressel Chantler seemed to say in her 1929 *Better Homes and Gardens* piece, “The Basement Beautified: The Cellar Now Emerges from the Obscurity of Olden Days.”<sup>700</sup> Relieved of dust, dark, and damp, Chantler wrote that “now cellars have blossomed.” In turn, the entire middle-class American family was heading downstairs and creating new practices of domestic life. Basements now hosted table tennis (Fig. 4.2), card games, and model trains, or could become what one homeowner called a “radio ballroom.”<sup>701</sup> Cement floors could be painted or covered with a new composite material so that children were not crawling on cold concrete. Some spring cleaning advice gave instructions for scrubbing the cement basement floor with water and brush, just to be sure the space remained inviting and sanitary.<sup>702</sup>

Chantler used mythic language for what awaited Americans who pioneered underground. She called the basement “reclaimed space,” evoking the irrigation projects in the arid West, drainage tiling in Midwest flatland, or infills in East Coast harbors that had seemed to make landscapes into something out of nothing. Chantler thereby intimated that a central characteristic of the American family was the itch to occupy more private space. The cemented basement was therefore more than an acceptable place to raise kids. It was an inviting frontier for national development, and perhaps also a laboratory for American family life. While homes lacking any basement or having only a crude cellar offered no margin in spatial efficiency, the cement basement offered such abundance that people could use it “in ways that anywhere else in the house would be considered wasteful.”<sup>703</sup>

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<sup>700</sup> Ethel Wan-Ressel Chantler, “The Basement Beautified: The Cellar Now Emerges from the Obscurity of Olden Days,” *Better Homes and Gardens* 8, no. 1 (September 1929): 49, 67, WMA.

<sup>701</sup> Helen Head Simons, “How We Solved Our Building Problem,” *Better Homes and Gardens* 3, no. 7 (April 1925): 85, WMA.

<sup>702</sup> Margaret M. Speechly, “Tools for the Spring Offensive,” *Chatelaine* 1, no. 2 (April 1928): 4, 41-42, WMA.

<sup>703</sup> Wan-Ressel Chantler, “The Basement Beautified,” 27.

Home basements were invaluable. In his 1917 *Domestic Architecture*, read widely among professionals in the subsequent years, the Oregon-based professor L. Eugene Robinson had written that the basement “has a number of uses which should not be neglected, or even put off as a last consideration.”<sup>704</sup> Foreshadowing Chantler’s conclusion, Robinson called it “economically necessary to use this space for a number of things which cannot be provided for upon the main floors.” Among these could be “a den, a play room, a shop, a servants’ sitting room, or a billiard room.” With full excavation a foregone conclusion in the northern United States, to leave the concrete-lined space as a simple cellar was to squander opportunity for your family.

Commentators into the 1930s echoed the sentiment that basements had progressed and ruptured into a distinct era from the olden days of damp subterranean spaces. As *Better Homes and Gardens* Carl T. Sigman and William J. Ward, Jr. put it in 1937, “the cellars of our grandfathers’ houses...were only for storage...but today cellars have become basements in which we live and play and work.” Few desired to build their lives within cellars of yore, and even fewer entrusted those spaces with things more precious than a canning jar or an already rusty implement. Now, in the 1930s, enviable homes from Syracuse to Cincinnati to Seattle had a reading area or an effective playground. The domestic subterranean was celebrated by homemaking advice columnists rather than admonished by health reformers.<sup>705</sup>

Sigman and Ward’s article—“How Dry I Am,” playing on a folk tune lyric that had found new life during Prohibition—asked readers: “Would you like your basement to sing this old refrain?” Their piece offered construction and renovation techniques that reflected elevated expectations for controlling environments underneath homes. This new advice indicated that a new chapter had begun in the history of basements, one defined by investment in basement living spaces. Cement had created healthy living and playing in the domestic subterranean, first making it imaginable, then realizable, then a cultural standard

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<sup>704</sup> Robinson, *Domestic Architecture*, 85.

<sup>705</sup> Carl Sigman and William J. Ward, Jr., “How Dry I Am: Would You Like Your Basement to Sing this Old Refrain?,” *Better Homes and Gardens* 15, no. 9 (May 1937): 34-35, 106-107, WMA.

for middle-class families across the country. Now, cement was the key material for protecting that standard of living and for protecting the home basement investments that individuals and families made in the middle of the twentieth century.

SAFE BASEMENTS: FINANCIAL PLANNING, FAMILY  
RECREATION, FALLOUT PREPAREDNESS, AND REMEDIATION  
IN AN IDEAL DOMESTIC UNDERGROUND

In 1938, when Zellis “Zip” Zeller and Clara Towns, each 22 years old, wed in their hometown of Broken Bow, Nebraska, neither likely imagined that two decades later a basement of theirs would achieve a modicum of fame.<sup>706</sup> Once married, Clara kept house; Zip’s career making technical drawings of machinery tools and parts began carrying the two gradually eastward, from Lincoln through Omaha and into Iowa. By 1955, they and their two daughters, Nancy and Bonnie, resided in a recently built one-and-a-half story home in Des Moines, where Zip was plant superintendent for Foxbilt Feeds, maker and packager of food for livestock.<sup>707</sup>

Zip was proud of that Des Moines home, and especially its basement. The locally based but nationally distributed *Better Homes and Gardens* featured the space in its April 1957 issue.<sup>708</sup> Like a growing number of American fathers in the 1950s, Zip had realized his vision of an ideal home life within that underground space. When Zip’s remodeling of the basement was complete, he had his own workshop, Clara had a laundry area, and Nancy and Bonnie had a playroom. The Zellers’ basement was a place in which security was both experienced in the present and extended toward an imagined future. It was the midcentury American ideal nuclear family substantiated: the children and each parental unit had their own basement space. Cement, and its allied technologies that together enveloped these underground compartments, gifted each Zeller a peace of mind about their role in the family and their respective paths forward, whether as growing children or as middle-class wage earners.

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<sup>706</sup> “Zellis Zeller Weds Clara Towns,” *The Custer County Chief* (Broken Bow, NE), January 27, 1938, 4, CA.

<sup>707</sup> *Polk’s Des Moines City Directory 1955* (Omaha, NE: R.L. Polk & Co., 1955), 913, accessed via Ancestry Library Edition.

<sup>708</sup> “Small Workshop with Big Ideas,” *Better Homes and Gardens* 35, no. 4 (April 1957): 86-89, 285-286, WMA.

Zip was confident in the cement itself, trusting that its exclusion of subterranean elements was reliable. Without that trust, he would have hesitated to fill the space with wooden and metal items (Fig. 5.1) and to make basement living a planned element of the Zellers' everyday lives. Though heavy use of cement in basement construction was hardly a foolproof plan for a clean and dry underground space, it had proved reliable enough in many homes across the country. The relatively new technique of pouring solid concrete foundation walls, detailed at the previous chapter's end, was critical to experiences and perceptions of reliability. However, issues of supply and demand for building materials and equipment in the postwar housing boom meant that many new basement walls, including the Zellers', consisted of concrete blocks cemented together by hand. Such concrete masonry was perhaps more prone to leaks than the poured-in walls and therefore less conducive to the full carpeting and furnishing in more upscale midcentury basements, unless the blocks were supplemented with petroleum-based coatings or sufficient gravel and tiling in the surrounding earth. Just the same, as Zip's renovations evidence, American families with any type of modern concrete basement were drawn into novel subterranean cultures that depended on entrusting their home lives to underground structures.



Figure 5.1. Zip Zeller in his basement workshop. Published with “Small Workshop with Big Ideas” in *Better Homes and Gardens* (April 1957), and viewed in the Proquest Women’s Magazine Archive.

In the years that followed, the four Zellers would also likely be among many Americans who, following official federal guidance, thought long and hard about their basement’s potential to help them survive a Soviet nuclear attack. Meanwhile, living among the creeks and rivers that fan through Greater Des Moines, they may too have been among those homeowners who reckoned with the fact that water could at least occasionally find its way into even a well-built basement. In the 1980s, when the Zellers had moved to a slightly newer home one mile away, they surely were informed of radon and the hazard it likely constituted in many Iowa basements.<sup>709</sup> Home fallout shelters, flood remediation, and radon mitigation were major twists on and complications of a home basement ideal that had come to influence

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<sup>709</sup> In 1993, when the United States Environmental Protection Agency published a map of radon advisory levels by county, EPA officials assigned the highest advisory level to all 99 of Iowa’s counties. “Iowa – EPA Map of Radon Zones” is published at <https://www.epa.gov/sites/default/files/2014-08/documents/iowa.pdf>, accessed April 17, 2025.

perceptions of personal and family security in the mid-twentieth century. Rather than simply realizing preconceived ideas of family security, basement environments were a known quantity from which prominent American imaginings of safe and fulfilling futures began. Indeed, basements participated in plans for maintaining or obtaining stability at the individual, family, and even national levels, and basement living achieved a cultural importance that even worrisome radon revelations could not undo.

This chapter describes the new era of American basements that began roughly around 1930. As discussed in the previous chapter, due to home heating and winter storage considerations, fully excavated cellars with concrete floors but typically brick or stone walls had long been the norm in the Northeast and North Central regions, common across the entire northern tier of the United States, and found in many other areas with less frequency. Now, the standard was to construct these full basements entirely with concrete. Even lower middle-class housing was likely to include a basement with a smooth cement floor and walls of concrete, whether poured or assembled with blocks. In the vernacular of some cities, like Milwaukee, basement duplexes or apartments became a common feature of the blue-collar residential landscape.<sup>710</sup> Some owners of older housing stock, with basements less conducive to modern, clean domesticity, began to renovate their underground spaces, starting with additional layers of cement. Accordingly, many mid-century homeowners—an intentionally inflated American demographic by the Second World War's end—presumed and depended upon cement for sealing off underground space. This differed markedly from the preceding era described in chapter four, in which fully concrete basements were less common, and the underground was not expected to be living space for homeowners.

Through the middle of the twentieth century, basement living space was not only common in many regions but also a site for distinct types of investment. These came in familial, social, personal, material, and financial forms. Parents built on earlier innovative basement use by mothers to more fully

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<sup>710</sup> “Chapter Four - The Dwellings of Modern Domestic Reform: Cottages, Duplexes, Multi-Units, and Remodeled Houses,” in Thomas C. Hubka, *How the Working-Class Home Became Modern, 1900-1940* (Minneapolis: University of Minnesota Press, 2020).

involve underground spaces in how they raised children. People of all ages developed friendships in one another's basements, supplementing or perhaps replacing their public socializing in pool halls, parks, and places of worship. Under their homes, individuals practiced skills of home improvement or read books or built muscles using home gym equipment. If some gym equipment went unused, it might have been in good company among accumulated items stored for possible future use—yet another role commonly given to basements. Together, types of investment that arose within basement space were intertwined with a national phenomenon of homeownership that made residential real estate a primary financial instrument for retirement or in leaving a material inheritance. Finishing or renovating a basement with the real estate market in mind took the space into an abstract dimension beyond daily life. Many basements therefore constituted multifarious investment portfolios, and cement was the linchpin of increasingly complex environmental systems that protected such investments.

While more and more Americans relied on concrete basement spaces, more and more became familiar with cement's limits. The earlier successes, described in chapter one, of cement chemists and civil engineers had indeed made concrete an effective barrier in many circumstances. Cement floors and walls were not, however, the strictly waterproof structures that builders and homeowners in earlier generations had imagined them to be. Through widespread basement living, twentieth-century Americans informally experimented with and encountered the extent of—not to mention, the circumstantial liabilities of—cement's ability to impede everything from water to mice to radioactive particles. This chapter therefore explores how as a basement ideal took hold among Americans they also had to consider, address, or ignore its limitations, especially amid real experiences of flooding and imagined experiences of nuclear attack.

### The New Deal and the New Ideal Basement

In 1930, the single-family home basement with space for recreational living still remained a rare and exclusive feature in the American housing landscape. However, the concept of the fully habitable

home basement was about to become mainstream. As seen in the previous chapter, national magazines defined the modern basement in text and in illustrations replete with ping-pong tables and kitchenettes, giving people across the country an image of the ideal domestic underground.

New Deal policies, beginning with the National Housing Act of 1934, officially tethered social and financial success to homeownership. Congress mitigated the risk that mortgage defaults posed to banks and depositors. Subsequent legislation bolstered alternative financing pathways that made it easier for many middle-income Americans to purchase homes. While failing to ensure that people of any race or ethnicity could access home loans, these acts nonetheless amounted to a declaration that single-family homes were a social necessity. Other New Deal measures defined a modern home in contrast to “slum” residences, a politically potent characterization of older structures that in many cases did lack healthful environmental technologies and arrangements but also disproportionately housed people of color and non-English speakers.<sup>711</sup> The New Deal’s definition of which housing was no longer acceptable both reflected and reinforced specific material and social desires held by many Americans. In this context, the family basement’s combination of novelty, hygiene, and exclusivity was a tangible, moralized antithesis to the much vilified and routinely demolished slum housing.

While Congressional committees were still considering the first housing act, Bernard L. Johnson stood before the 1934 National Association of Real Estate Boards convention and named “security and privacy and independence” as universal goals for a home. Johnson, the editor of *American Builder*, a journal that glorified single-family homes in idyllic arboreal suburban neighborhoods, surmised that those goals could be achieved only by “ownership of a little piece of mother earth with a snug little house and a fence around it!”<sup>712</sup> Johnson reflected and perpetuated a view that the most satisfying home experience

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<sup>711</sup> *An Act to Provide Financial Assistance to the States and Political Subdivisions Thereof for the Elimination of Unsafe and Insanitary Housing Conditions for the Eradication of Slums, for the Provision of Decent, Safe, and Sanitary Dwellings for Families of Low Income, and for the Reduction of Unemployment and the Stimulation of Business Activity, to Create a United States Housing Authority, and for Other Purposes*, Public Law 75-412, *U.S. Statutes at Large* 50 (1937): 888.

<sup>712</sup> As quoted on the inside cover of *American Builder*, *Big-Value Homes*.

was one of separation, both physically and financially. Satisfaction in life required legal authority and financial capacity to invest materially in your family's home and thereby create comfortable isolation from the surrounding world. *American Builder* claimed buyers could trust not only new homes' financial security, thanks to federal insurance, but also their structural security, thanks to advanced techniques and materials.<sup>713</sup>

The modern family basement was an obvious case of advanced home construction, but it also contributed to the new home-centric definitions of financial independence and prudence. A home basement was increasingly seen as a dependable and potentially productive financial asset. In 1932, for example, a Chicago area publicist named Norman Radder and his wife, Elsie, were set on transitioning from renting to owning while remaining in the affluent suburb of Wilmette.<sup>714</sup> They were pleased to find a one-story bungalow with a full basement, which doubled the home's interior space. The Radders appreciated that the previous owner had kept the basement relatively clean and that "the concrete floor was in good condition." Yet Norman noted that "no attempt had been made to make any of the space attractive for recreation purposes," a fact he called "such a waste" (Fig. 5.2a). So, the Radders promptly replaced the coal-fired boiler with a compact, oil burning hot-air furnace and built a workshop in the old coal bin. The largest space, its floors now enameled a vibrant blue, and its walls painted a pleasant yellow, became a reading den that occasionally hosted parties for their young children (Fig. 5.2b). Fully modernizing their basement as living space both suited their family of four and allowed them to build

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<sup>713</sup> "More House Today for The Money than in 1926 or 1929," *Big-Value Homes*, 12.

<sup>714</sup> Norman J. Radder, "The Basement Steps Out: How Mine Became a Delightful Hobby and a Source of Enjoyment for the Entire Family," *Better Homes and Gardens* 13, no. 9 (May 1935): 42-89, WMA. Details of the family members and their housing transition found with "Norman J. Radder," in U.S. Bureau of the Census, *Fifteenth Census of the United States, 1930*, New Trier, Cook, Illinois, Enumeration District 16-2214, Sheet 1B, Line 58, accessed via Ancestry Library Edition.

equity in their home, maintaining its value relative to the more ostentatious houses on their block.

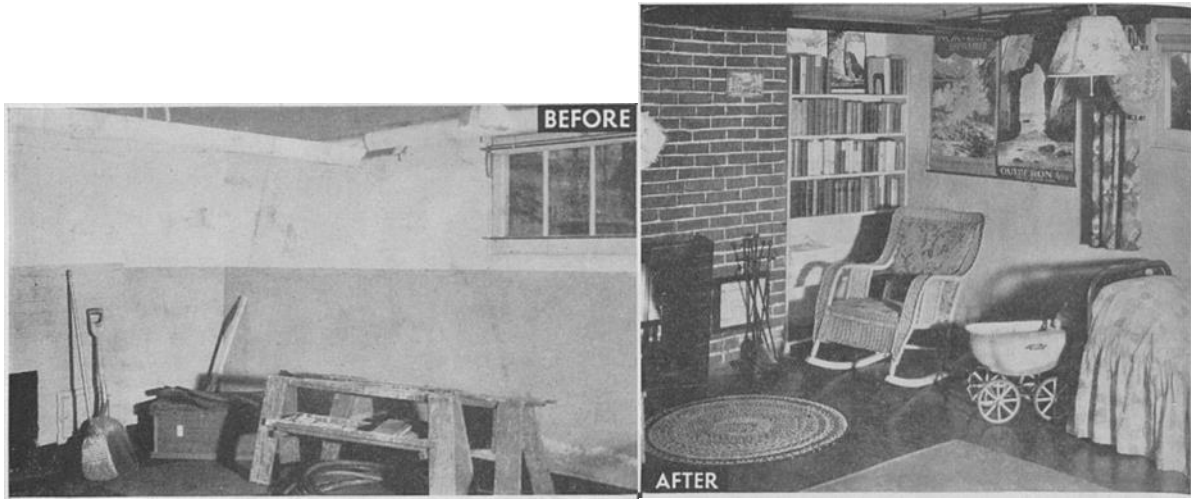


Figure 5.2. A before-and-after set of photographs showing how the concrete basement purchased by Norman Radder was sturdy, sealed, and otherwise well-maintained but had not been realized as the underground living space that fully cemented basements encouraged and protected. Published with “The Basement Steps Out” in *Better Homes and Gardens* (May 1935), viewed in the Proquest Women’s Magazine Archive.

Do-it-yourselfers like the Radders as well as professional builders and architects worked to, as one writer put it, “transform useless basements into attractive livable rooms.” Expert help could go beyond painting walls and floors and into the creation of entirely distinct spaces. Many basement remakes relied on new industrially processed construction materials including petroleum-based waterproofing agents, mineral wool insulation, and preformed paneling. Some panel consisted of asbestos mixed with various substances including cement, as in the transite walling products popularized by the Johns-Manville Corporation.<sup>715</sup> More affordable, though more vulnerable to moisture and less a barrier to sound and air, were pre-made walls of engineered wood matter, including the trademarked Masonite.<sup>716</sup> In the

<sup>715</sup> “No Less Than ‘Amazing’: Two Basement Transformations,” *Big-Value Homes*, 152-153.

<sup>716</sup> Benjamin F. Betts, “Modern from Basement to Roof,” *Better Homes and Gardens* 16, no. 4 (December 1937): 67, WMA; “Advertisement: Masonite,” *Better Homes and Gardens*, 8, no. 6 (February 1930): 71, WMA.

1930s, the eponymous corporation explicitly advertised its products for dividing open basements into specialized rooms comfortable enough for everything from family recreation to sleeping (Fig. 5.3).



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GAME-ROOM  
IN THE  
CELLAR? HOW  
GRAND!"**

**"YES, WE FOUND WE  
COULD AFFORD IT—  
WITH MASONITE!"**

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Figure 5.3. Images from the 1930s demonstrating that basement development became a selling point for Masonite boards: Above, a 1937 advertisement brought up familiar themes of basement living as economical while evoking the fun and satisfaction that could be had underground. At right, an earlier advertisement, from 1930, tied family growth to the construction of extra rooms in spaces that included the basement.

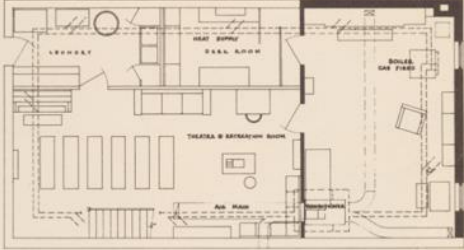
In the mid-1930s, the American Radiator Company, to advertise how compact and clean its new heating systems were, conducted a contest in which homeowners submitted photographs of renovated basements. In 1936 the company published the results in *Castles Underground, the Cellar Reborn*, which featured the products of honored contestants who were all homemaking women and most, from the looks of the results, apparently also mothers. These modernized basements were geographically weighted toward the Upper Midwest and New York state, as had become typical, but they also included entrants from Virginia, North Carolina, Georgia, and even Stockton, California. The booklet also displayed images of several basements that had not yet been renovated, some with coal strewn across the floor, most with exposed brick walls, and all with an obtrusive furnace and sprawling ductwork. Alongside floor plans for how those cellars might be reborn, as they said, into basements were a set of cost estimates for what that work would entail. The first step in any renovation was to address needs for cement, whether resurfacing a chipped concrete floors or coating a brick wall with cement finish. At the booklet's end was a "Specifications" page that specified to the tenth of a ninety-four-pound sack how much cement should be used, respectively, for 100 square feet of walls and floors and how thickly it ought to be applied.<sup>717</sup> By the American Radiator Company's estimates, cement prices had held fairly steady since a few decades prior, making such renovation a very attractive alternative to seeking a new home with a poured concrete basement.

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<sup>717</sup> Parsons School and the American Radiator Company, *Castles Underground, the Cellar Reborn* (New York, 1936), CHM.



**EXISTING CONDITIONS**




**CONVERTED FLOOR PLAN\***

TWO PIPE VAPOR HEATING

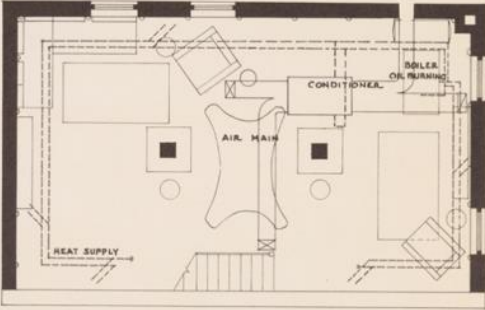
**COSTS FOR CONVERSION**  
AFTER INSTALLATION OF CONDITIONING EQUIPMENT

<p><b>STRUCTURAL ALTERATIONS</b></p> <p>Erection of new partition <span style="float: right;">\$ 45.00</span></p> <p><b>WALLS</b></p> <p>Cement finish <span style="float: right;">35.00</span></p> <p><b>CEILING</b></p> <p>Patched and painted</p> <p><b>FLOOR</b></p> <p>Cleaned</p>	<p><b>CABINET WORK</b></p> <p>Benches, wall seat, etc. <span style="float: right;">\$100.00</span></p> <p><b>PAINTING</b></p> <p>Walls, ceiling, including patching, and furniture <span style="float: right;">60.00</span></p> <p style="text-align: right;"><b>TOTAL</b> <span style="float: right;"><u>\$240.00</u></span></p> <p><b>SPECIAL FURNISHINGS</b> <span style="float: right;">\$35.00</span></p> <p style="font-size: small; text-align: center;">Optional-Composition floor-\$90.00 additional</p>
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\*Part of plan outlined in black is part used for the room shown on opposite page.



**EXISTING CONDITIONS**



**CONVERTED FLOOR PLAN**

TWO PIPE VAPOR HEATING

**COSTS FOR CONVERSION**  
AFTER INSTALLATION OF CONDITIONING EQUIPMENT

<p><b>STRUCTURAL ALTERATIONS</b></p> <p>Demolition of coal bin <span style="float: right;">\$ 5.00</span></p> <p><b>WALLS</b></p> <p>Plastic finish, with birch trunk decoration <span style="float: right;">62.00</span></p> <p><b>CEILING</b></p> <p>Patched and painted</p> <p><b>FLOOR</b></p> <p>Painted</p>	<p><b>CABINET WORK</b></p> <p>Bookshelves, column shelves, seat with upholstery <span style="float: right;">\$ 99.79</span></p> <p><b>PAINTING</b></p> <p>Ceiling, including patching, floor, furniture and wall decoration <span style="float: right;">58.00</span></p> <p style="text-align: right;"><b>TOTAL</b> <span style="float: right;"><u>\$224.79</u></span></p> <p><b>SPECIAL FURNISHINGS</b> <span style="float: right;">\$ 88.00</span></p> <p style="font-size: x-small; text-align: center;">Optional-Refinishing floor with markings-\$28.00 additional</p>
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Figure 5.4. A page from the 1936 American Radiator Company publication Castles Underground featuring images of existing conditions and converted floor plans of two basements. Image courtesy of the Chicago History Museum, IChi-189026.

Through the 1930s, getting “more house for the money” remained a theme in discourse on American homes that constituted a fine case for finishing the basement level. In new suburban developments from Long Island to the outskirts of Chicago, the apparent economy of underground living space meant a home without a basement required its own justification. Developers and realtors in these markets found that selling such homes required “a great deal of promotion and education.”<sup>718</sup> One basementless home in Berwyn, Illinois was advertised specifically for “a young couple or two elderly people who desire the compactness of an apartment and at the same time live in their own house.”<sup>719</sup> The lack of basement made the stand-alone house effectively an apartment space, which insinuated no one could comfortably raise children there.

Some builders marketed basementless homes by addressing head-on the issue of thriftiness. E.E. Olsen Construction Co. of Pittsburgh, for example, advertised “basementless utility houses” as saving the buyer \$1,000 from a \$7,250 equivalent with basement.<sup>720</sup> Olsen carved out a first-floor utility closet for home elements, including laundry and heating unit, that were then typically located in area basements. The scheme benefitted from the region’s established use of natural gas rather than space-consuming coal. Natural gas was ascendant nationally, but piped-in energy did not remedy all problems of ditching the basement. Builders of a basementless house in New Canaan, Connecticut found they needed to insulate the first-floor utility room walls on account of noise. It turned out that one benefit to a basement was the sequestration of loud heating appliances.<sup>721</sup> The cost of heating a basementless home was perhaps only half, just five dollars each month as opposed to eight or ten.<sup>722</sup> Yet those future savings may have been harder to imagine than were the future earnings from a home with basement.

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<sup>718</sup> R.E. Sangster, “\$1,000 More House for the Money,” *Big-Value Homes*, 57.

<sup>719</sup> *Big-Value Homes*, 42.

<sup>720</sup> *Big-Value Homes*, 164.

<sup>721</sup> *Big-Value Homes*, 68.

<sup>722</sup> *Big-Value Homes*, 60.

Increasingly, homeowners thought with basements in mind not only when considering the initial purchase of a home but also when considering its eventual resale. *American Builder* contributor R.E. Sangster offered the term “salability” to describe a generational shift toward building homes for mass appeal both initially and in the future.<sup>723</sup> Fewer homes were owner-built and more were constructed by operative builders who were then responsible for selling on the market, a market in which the stakes of “salability” were amplified by the new Federal Housing Administration’s inclusion of a resale estimate in its mortgage insurance decisions. Many homeowners were becoming not just people living in a space to which they held legal title but people managing the space as the biggest financial asset they owned. Basements increased a home’s salability, and the extent to which they did so was determined in part by the amount and quality of cement that sealed each basement’s floor and walls.

As the Radders had demonstrated, basement renovation, or even its pre-construction design, could be both an intensely personal vision for the family’s future and a financial investment subject to outside critique. One *American Builder* critic pilloried a 1935 owner-built cottage for having a carelessly planned basement that held little value. The expert drew up a revised floor plan with a thick concrete floor and perimeter walls and a concrete bisecting wall to divide utility space from “the basement recreation room with fireplace.”<sup>724</sup> This more market-oriented basement had convenient storage space and potential for finishing and furnishing. The value of a basement did not come from having what one home construction advisor called “the fixings” from the start.<sup>725</sup> Rather, value came from a solid concrete frame that might eventually be filled with plush seats, game tables, hobby equipment, and more. Basement life was becoming so widely desired in the much of the United States that architects retrofitted them into older and typically more humble home plans. Some, for instance, modernized the Philadelphia row house

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<sup>723</sup> *Big-Value Homes*, 28-29.

<sup>724</sup> *Big-Value Homes*, 55.

<sup>725</sup> John Cummings Lindop Real Estate, Inc., in *Big-Value Homes*, pp48-49.

with a poured concrete basement divided into pine-paneled recreation room, utility and laundry areas, and perhaps a lavatory.<sup>726</sup>

The increasingly clear vision for home basement recreation meant that in homes where utilities remained in the basement, those utilities needed containment. Newer designs minimized ductwork to, as one writer later put it, “unobjectionable proportions” that neither crowded the basement nor interfered with people’s ability to stand up straight.<sup>727</sup> New furnaces and boilers, in contrast to their rough iron predecessors, had enamel coatings and sheet metal casings that could be scrubbed and dusted as was any piece of furniture upstairs. New coal bin solutions combined with the general trend toward oil and gas heating to continuously reduce dust in the average basement. Some who still stored coal, and the distinct minority who still needed a wood lift and ash pit for fireplaces above, managed basement dust by investing in floor-to-ceiling plaster walls and strategic rubber stripping.<sup>728</sup>

Coal was a unique threat to the ideal basement environment. Throughout the 1930s, the National Coal Association attempted a last-ditch effort to save room for coal in new houses or “modernizing old ones” by promoting new bin designs. The recommended bins were essentially storage sheds within the basement. The idea was that their solid walls—made of concrete, when possible—would be complemented by angled chutes, layers of hatches, and precise thresholds that could together contain the sooty rocks and keep basements clean even with coal present. Another option was to relocate coal storage outside the basement footprint, such as to a void beneath the garage.<sup>729</sup> These were attempts to make coal more like oil in neatly filled tanks or even like piped-in gas, and therefore more compatible with modern basement life.

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<sup>726</sup> R.E. Sangster, “First Modern Row Houses in Chicago Find Ready Market,” *Big-Value Homes*, 163; “Those Philadelphia Row Houses!,” *Big-Value Homes*, 168-169.

<sup>727</sup> B. Kenneth Johnstone, Clinton Lee Harris, Royal Matthew Gerhardt, Louis Alexander Richardson, and Elliot Leonard Whitaker, *Building or Buying a House: A Guide to Wise Investment* (New York: Whittlesey House, 1945), 85.

<sup>728</sup> Roy Whitfield Wright, “A Story in Your Basement,” *Ladies' Home Journal* (April 1929): 124, 126, WMA; *Big-Value Homes*, 107; *Big-Value Homes* 118.

<sup>729</sup> “How to Build Modern Coal Bins,” *Big-Value Homes*, 84.

More and more, basement investment included heating and electrifying the underground. Some basements could be heated by simply removing the insulation from exposed steam pipes, but the higher standard was to keep those concealed and use additional equipment such as ceiling radiators. Electric space heaters were increasingly an option, since by some estimates the average 1938 home had fifty percent more electrical outlets than a decade earlier. Besides adding options for heating, electrification of basements ushered in new laundry equipment and opened new recreational opportunities in underground spaces. Artificial lights illuminated the space far better than daylight windows and for much more of the day, into the evening time. After dinner or after kids went to sleep, some Americans could now head underground to read leisurely, play board games, dance, and listen to a radio program.<sup>730</sup> As those possibilities became better known, some US home builders determined that to not include at least one so-called convenience outlet in the basement was to face certain “electrical obsolescence.”<sup>731</sup>

The introduction of new technical systems like electrification increased the degree to which males took on responsibility for curating and maintaining the home basement. Relatedly, while women had taken the lead in parenting with basements, in the 1930s more men also began to explore the basement as a venue for fathering. By realizing its potential uses for others, a dad could use the basement to show care and embrace responsibility while investing in his family’s future. A 1931 feature on the home that L.C. Kent, an engineer with the National Electric Light Association, had partnered with an architect to design for his family began, “Rare is the home that has been wired with special consideration for the children!” But that was just what Mr. Kent had done by, for instance, illuminating the basement recreation room “such that the children can stage anything from kiddie-car races or violent roller skating to fine stitching or reading, without eye-strain.” Mr. Kent and his wife had created this space knowing that “youngsters

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<sup>730</sup> Some Americans in the 1920s, self-described pioneers of the modern basement, had established the space as a venue for radio. What one man called his “radio ballroom” was featured in an early display of the new basement ideal: Helen Head Simons, “How We Solved Our Building Problem,” *Better Homes and Gardens* 3, no. 7 (March 1925): 85, WMA.

<sup>731</sup> *B-VH*, 91.

will make a playroom out of any or every room in the house if they have no special domain of their own.” So, of course, the room “was planned for the basement, where the children can frolic to their hearts’ content.”

In 1939, a Mr. Haselton turned his family’s basement outside Albany, New York into a place of whimsy and play for his daughter, Barbara, and her big brother, Kenneth. Mr. Haselton, a financial investor by day, covered the basement in murals depicting Disney characters. Their basement also featured a shuffleboard court on the smooth floor, a foldable ping-pong table, and a large sofa with reading lamps on end tables, but these elements for more mature recreation existed under the dominating gaze of Mickey, Donald, Pluto, Snow White, and the Seven Dwarfs.<sup>732</sup> Fathers then establishing new cultures of male domestic activity were also learning what a helpful tool the modern basement could be.<sup>733</sup>

#### Early Brushes with the Limits of Cement Barriers

At the turn of the century, homebuilders had rarely laid foundations intended to exclude water, smells, dirt, and pests to such a degree as to permit comfortable basement living. But after 1930, that was exactly the goal of many builders. It was also an expectation of many prospective homeowners. Desires for basement space to be a thoroughly dry, warm, and otherwise controlled environment sometimes outstripped what concrete and cement alone could ensure. Supplemental interior sealants and exterior drainage systems therefore became standard advice for basement construction. These companion technologies to cement could both address shortcomings of earlier concrete work and account for limits to cement’s impermeability, which were magnified when cement was diluted by sand and gravel in

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<sup>732</sup> “Fairy Tale Basement: Mickey Mouse, Donald Duck, and Snow White and the Seven Dwarfs Came to Slinget-Lands, New York, and Liked It So Well They Stayed Over in the Basement of K. E. Haselton,” *Better Homes and Gardens* 17, no. 7 (March 1939): 42, WMA.

<sup>733</sup> Katherine Goepfinger, “Lighting the Home of an Illuminating Engineer,” *Better Homes and Gardens* 9, no. 7 (March 1931): 43, 82, WMA.

concrete.<sup>734</sup> Like the surface level roofs and walls, fully walling of the family basement from the outside environment proved more difficult than anticipated. Yet engineers and architects continued to respond with improved techniques.

Diagrams and explanations of home basement construction ostensibly considered a national audience, but the advice described combinations of seasonality and precipitation most common in the North Central and Northeast. Advice considered soil types and gravel infill, alternately addressing sites with optimal drainage and those, as one described it, in “localities where excessive rains, occasional floods and subsurface water are encountered.”<sup>735</sup> At sites in the former category, a few inches of dense concrete floor might need only a supplemental  $\frac{3}{4}$ -inch coating of purer cement to be waterproof. The walls could be waterproofed with a similar treatment, jointed and coated with stiff cement mortar over solid concrete, concrete blocks, or other masonry units like brick. Some older basement surfaces of rough or uneven concrete could be made trustworthy by a smooth coat of cement or insertion of tar, pitch, and other molten, rubbery materials into the cracks and joints.

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<sup>734</sup> *Big-Value Homes*, 72 mentions a supplemental engineered drainage system: “Foundation: Concrete footing; 5x8x12 tile walls; basement and garage floors, 4” concrete; drain tile around wall to insure dry basement.”; also, *Big-Value Homes*, 122, home by L. Morgan Yost, A.I.A., Wilmette, Ill., Designer and Builder included “Foundation drain tile to insure dry basement.”

<sup>735</sup> Johnstone et al., *Building or Buying a House*, 35.

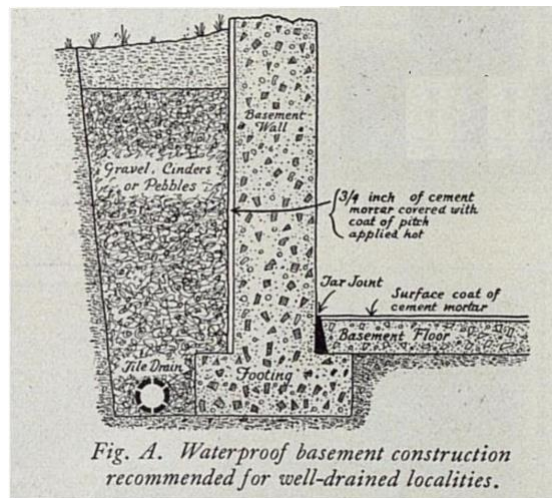
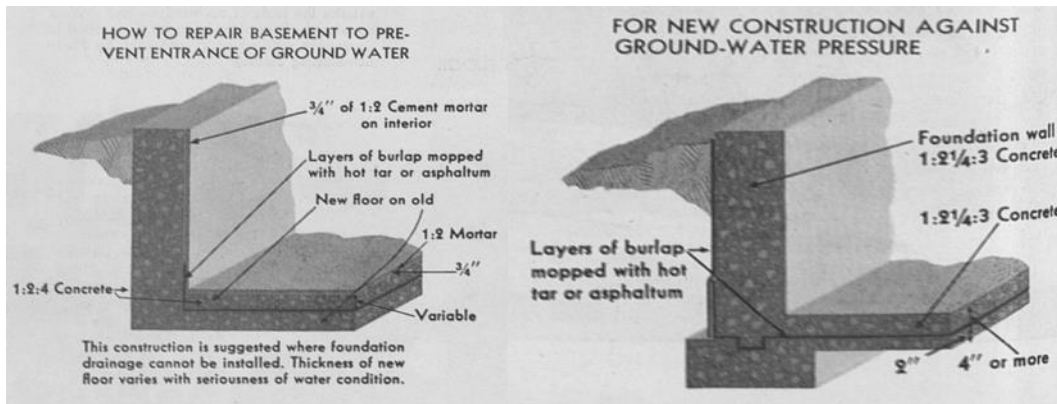


Figure 5.5. Example diagrams, printed in domestic periodicals and books that encourage homeownership, showing cement and concrete's role in securing a dry basement either during initial construction or as a subsequent fix. The top two images were published with "How Dry I Am" in *Better Homes and Gardens* (May 1938) and the bottom image was published with "A Story in Your Basement" in *Ladies' Home Journal* (April 1929), both in the Proquest Women's Magazine Archive.

In areas prone to seasonal deluges or where some combination of climate, topography, and soils inhibited drainage, even carefully constructed concrete could need help in sealing off the basement.<sup>736</sup> Home construction journalists Carl T. Sigman and William J. Ward, Jr. detailed the additional assistance cement sometimes required in their 1937 *Better Homes and Gardens* piece. Sigman and Ward declared that "a well-constructed basement should be just as effective in keeping water out as a swimming pool is

<sup>736</sup> Johnstone et al., *Building or Buying a House*, 87.

in keeping water in.”<sup>737</sup> If subsurface water periodically accumulated around the home, it would do what water has always done and traverse any pore or crack no matter how small. Liberal application of viscous substances including tar or asphalt or pitch constituted one potential aid. Liquified with relatively little heat, those materials could be swabbed on a basement floor or laid down in the form of saturated burlap. The pitch would then gravitate into and fill the voids through which pressurized water could otherwise infiltrate.

Even in well-drained areas, homeowners pushed the limits of cement’s moisture control abilities such that concrete often needed technological assistance. Roof guttering and down spouts needed to discharge water into underground drains or otherwise carrying safely away from basement walls. Basement window wells needed their own systems of water management so as to not become pools abutting the home. Windows needed thin metal frames that changes in temperature or humidity could not warp and interrupt the basement’s waterproof seal. In another attempt to complement cement, paint companies mixed special products to use directly on concrete and address the material’s tendency to get cold and accumulate condensation. As Americans emplaced more tiles, planks, or linoleum squares that added to the basement space’s insulation from the surrounding earth, preservation of those materials depended on not only cement but also an additional moisture control layer consisting of paint, some other waterproofing compound, or even an air-filled gap.<sup>738</sup>

Many home building recommendations made no distinction between drier or wetter areas. In the 1930s, the universally suggested thickness for concrete floors and walls increased to at least four inches, a standard that would double by the 1940s.<sup>739</sup> Building experts promoted additional waterproofing agents that ranged from wax to asbestos fiber, from coal-tar to sheet copper to felt.<sup>740</sup> Hardware stores offered

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<sup>737</sup> Carl Sigman and William J. Ward, Jr., “How Dry I Am: Would You Like Your Basement to Sing this Old Refrain?,” *Better Homes and Gardens* 15, no. 9 (May 1937): 34, WMA.

<sup>738</sup> Wright, “A Story in Your Basement,” 126.

<sup>739</sup> Johnstone et al., 87, stated “For a small house the foundation walls should be at least 8 in. thick for concrete block, poured concrete or brick, [more for stone].”

<sup>740</sup> Sigman and Ward, “How Dry I Am,” 106.

mysterious waterproofing compounds intended for mixing into cement. Some advisors claimed that modern, watertight basement walls could still be constructed of fieldstones if the builders properly employed cement mortar.<sup>741</sup> Others declared that only walls of solid poured concrete with no masonry joints were satisfactory. Home construction professionals knew that option was too expensive for many families, but they maintained that all should strive for a thorough, dense lining around the basement space. Sigman and Ward simply proclaimed, “less density means water seepage,” and directed further questions on constructing a dense basement to the Portland Cement Association at their downtown Chicago address.<sup>742</sup> Other home construction advice writers linked consummate basement construction to the longstanding civil engineering goal, chronicled in chapter one, of proportioning Portland cement with sand or gravel to “provide the maximum density” in concrete or mortar.<sup>743</sup>

Sigman and Ward ended their 1937 article with another axiom entailing generous cement application: “Basement recreation rooms obviously must be dry.” Model versions of the underground’s focal recreation room now had carpeting and wood-paneled walls. It was a place to live, work, play, and even eat.<sup>744</sup> It was to remain socially vibrant and materially useful for years to come.<sup>745</sup> Some builders of single-family homes now deployed cement and supplemental sealants toward a recognized vision of underground domestic life. Some architects began to argue that all homes should be sited outside floodplains to guarantee a useful basement.<sup>746</sup> In their view, a parcel’s inability to host a dry basement left it unworthy of any house at all.

#### The State of the Basement at War’s End

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<sup>741</sup> Johnstone et al., 86.

<sup>742</sup> Sigman and Ward, 35.

<sup>743</sup> Johnstone et al., 119.

<sup>744</sup> Dorothy Blake, “We Eat all Over the House,” *Good Housekeeping* 104, no. 1 (January 1937): 120, 172, WMA.

<sup>745</sup> Sigman and Ward, 107.

<sup>746</sup> Johnstone et al., 36-37.

In 1945, when millions of Americans turned from direct and indirect participation in war to domestic endeavors, the virtues of basement living were increasingly seen as self-evident to many Americans. Among the evidence for this were new architectures for entering basements. Traditionally, basement access had been accessed through a kitchen stairwell, connecting a trifecta of domestic work most often seen as female: cooking, food storage, laundering, and even, in many cases, tending the heating plant. But with the new basement rec room viewed as the ideal receptacle for rambunctious play too rough for more formal living rooms, the traditional kitchen staircase channeled unruly children right through dinner preparations.<sup>747</sup> Architects, builders, and buyers increasingly decided that a better design was a set of stairs coming from a central hallway, helping the basement to, as one commenter put it at the time, “be knit integrally with the living space above grade.”<sup>748</sup> A more central basement stairway better linked to the front door, lavatories, and anywhere else someone, especially children, might want to go from or to the basement.<sup>749</sup>

The more prominent placement of basement access demonstrated full trust that cement would stop the unhealthy, or at least unpleasant, effluvia that otherwise emanated from the ground. In split-level homes, there was no longer even a basement door to close and the lower floor was as convenient to access from the main entrance as was the floor above it. Having gained such trust and prominence in the postwar era home, concrete basements both shaped how Americans conceived of themselves, parented and planned for children’s futures, and made financial planning decisions. The cultures that emerged within these fully concrete basements also, in turn, constantly elevated standards for cement application. If many homeowners had once had little choice but to grudgingly accepted some amount of water, pests, dirt, and odors in underground spaces, these were now totally unacceptable to the owner of a modern basement.

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<sup>747</sup> *Big-Value Homes*, 132.

<sup>748</sup> Elliot Leonard Whitaker, “Basement Design,” *Journal of the American Institute of Architects* 5, no. 2 (February 1946): 91; *Big-Value Homes*, 122, describing homes by L. Morgan Yost, A.I.A., Wilmette, IL, Designer and Builder.

<sup>749</sup> *Big-Value Homes*, 76.

They were not only vague threats to household health, but also undeniable menaces to the material wealth and the day-to-day activities that comprised the ideal American family life. A flood or a sewage back-up or an infestation would be costly in its damage to carpets, paneling, furniture, and more, but would also disrupt family life.

The link between modern homes and planning for the future was explicit in *Building or Buying a House: A Guide to Wise Investment*, a 1945 publication of five professors in the Department of Architecture in Penn State's School of Engineering. The men, led by department head Kenneth Johnstone, assumed that their readers "belong to that great class of Americans who look forward to 'owning a home someday.'"<sup>750</sup> *Building or Buying* captured the zeitgeist of economical and profitable homeownership and conveyed that by making proper decisions—on matters ranging from site topography and existing utility infrastructures to whether there was a "trend of expansion of racial groups"—homeowners could minimize upfront costs while maximizing their eventual return.<sup>751</sup>

No surprise, then, that the *Building or Buying* authors gave serious consideration to the basement and especially to its security against water when building a new home.<sup>752</sup> That security began with cement, which undergirded the basement's other systems of environmental control. Acknowledging the appeal of upfront cost savings from a dirt floor or brick foundation walls, they nonetheless prescribed thick concrete all around. Beyond water considerations, they reminded readers that concrete surfaces were easy to clean and could "keep your home free of vermin." Other similar publications added protection against subsidence to the list of longstanding considerations of basement construction that now translated to generous cement use. Builders who skimmed on underground concrete were compromising not only structural integrity of the home above but also all the opportunities that existed within foundation walls.<sup>753</sup>

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<sup>750</sup> Johnstone et al., v, ix.

<sup>751</sup> Johnstone et al., 21.

<sup>752</sup> Johnstone et al., 87.

<sup>753</sup> Weyerhaeuser Forest Products, *The High Cost of Cheap Construction* (St. Paul, MN: Weyerhaeuser Sales Company, 1950), 6, 11.

*Building or Buying* co-author Elliot Leonard Whitaker was a basement expert. In late 1945, he presented a de facto State of the Basement address at a Penn State conference on heating and housing. Whitaker then published the speech as "Basement Design," an article in the *Journal of the American Institute of Architects*. Whitaker summarized American home basement history along a neat linear progression from basementless Colonial era structures to functional root cellars to spaces for the “gargantuan” and gravity-dependent central furnaces of the late nineteenth century. He noted that since 1920 home basements had undergone a complete makeover, and yet he worried that too many remained that were “dark, incongruous” assortments of utilities and undeveloped storage space.<sup>754</sup>

Whitaker’s vision for American homes in the nascent postwar period was like that of many domestic architects in that it centered on the modern housewife caring for home and family without the aid of any servants, making “efficiency and step saving” essential.<sup>755</sup> On those grounds, basements, which added steps for a homemaker, might well have been classed as a liability.<sup>756</sup> Whitaker, however, found reason for further investment in basement living. For one, in most locations building costs had jumped thirty to fifty percent over prewar values, making the argument for basements as economical extra space as strong as ever.<sup>757</sup> For another, basements were opportunities for a sense of individuality in the era of mass-produced suburbia. Whitaker opined that since “no two families' needs or activities are alike,” basement space was important for hosting the woodworking, photography, freezing food, and any number of other activities that made each person and each home what they were. Americans homeowners could cultivate new skills and maintain this array of practices because of the homogeneous concrete basement.

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<sup>754</sup> Whitaker, “Basement Design,” 86.

<sup>755</sup> Whitaker, “Basement Design,” 87.

<sup>756</sup> Indeed, many home architects and commenters at the time advised bringing laundry equipment upstairs. See, for example, “Five Laundries Planned Especially for Households with Children,” *Parents' Magazine* 19, no. 11 (November 1944): 36, WMA.

<sup>757</sup> Whitaker, 88.

This environment enabled them to construct new niches in the domestic subterranean and to inhabit the space with a carefree sense of privacy, control, and possibility.<sup>758</sup>

Postwar Housing Boom: A Case Study in Skokie, Illinois

The first nationwide US census of housing, conducted in 1940, intended to gather “information...on the utilization and characteristics of the housing supply.”<sup>759</sup> As a report on residential quality, the census measured progress toward the modernization goals laid out in Congress’ various 1930s housing acts. Over the subsequent decades, the census’s somewhat incidental quantitative data provided statistics on a phenomenal period of home construction. Basements did not appear in the data until 1960. The 1940 and 1950 housing censuses, though they did not specifically mention basements in the data, still provided statistics about the form of residential development in which midcentury concrete basements were standard throughout many of the country’s regions. From this, some basic inferences follow about, broadly, which Americans were more likely than others to be spending time in a concrete basement space that they owned.

The fast rise in the number of US homes following the Second World War was palpable in much of the country. Housing units increased from 37.4 million in 1940 to 46.1 million in 1950 and again to 58.3 million in 1960, a roughly twenty-five percent increase each decade.<sup>760</sup> The net addition of some 12 million units in the 1950s came from 16 million newly constructed units, less nearly four million units decommissioned by various processes including the federally subsidized slum clearance in many urban cores. As total housing units reached unprecedented heights, so did the homeownership rate. Sixty-two percent of housing units in use during 1960 were owner-occupied, the highest level since census takers

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<sup>758</sup> Whitaker, 90.

<sup>759</sup> “Part 1: United States Summary,” in U.S. Department of Commerce – Bureau of the Census: Housing Division, *1960 Census of Housing Taken as Part of the Eighteenth Decennial Census of the United States* (Washington: US Government Printing Office, 1963), xvii.

<sup>760</sup> *1960 Census of Housing*, xix.

first asked about tenure in 1890. This change was racially uneven. Homeownership rates among nonwhites were lower across the country and varied significantly by region, from a low of twenty-seven percent in the Northeast to a high of forty-five percent in the West.<sup>761</sup>

The disproportionately white homeownership boom in many regions largely involved an abrupt movement to urban fringes. In 1960, more than four in every five U.S. homeowners lived in a different home than they did in 1940. Nearly half had moved into their current home since 1953. That proportion surpassed fifty percent for the suburban places that the Census recorded as “Inside Standard Metropolitan Statistical Areas: not in central cities.” This growing edge of American life was also the literal edge of urban development, a formulaic environment that not only drew political and economic favors but that was also the most likely venue for modern basement living.

Zip and Clara Zellers’ 1950s residence, with its publicized basement mentioned at the start of this chapter, was one example. The home sat on a lot 50 feet wide and 132 feet deep—exactly as did the forty-five others on their quarter-mile block of 57th Place. Two parallel blocks to the east were also subdivided into twenty-three lots per side. To the north, beyond each road’s intersection with Forest Avenue, the same parceling repeated for another quarter-mile. Every lot, all developed between 1947 and 1950, contained a small house, a driveway, and a detached garage. With slight variations, that pattern of new housing development stretched across thousands of acres on Des Moines’s northwest side. It was at once an unstable landscape, suddenly remade during the postwar housing boom, and a landscape the Zellers trusted to secure their family’s financial and social future. Indeed, Zip and Clara would remain in northwest Des Moines for four decades, moving only once.<sup>762</sup>

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<sup>761</sup> *1960 Census of Housing*, xxvi-xxix.

<sup>762</sup> My characterization of this neighborhood is drawn from Zillow listings and Google Maps information on these blocks. For examples, see Google, “Streetview” digital images, Google Maps, photograph looking due north from the fire hydrant outside 1312 57<sup>th</sup> Place, Des Moines, Iowa, 50311, taken May 2021, <https://maps.app.goo.gl/k3f4TDHWrLP7r2Gm6>, accessed April 22, 2025; “1317 57th Pl, Des Moines, IA 50311,” Zillow, Inc. Brokerage, [https://www.zillow.com/homedetails/1317-57th-Pl-Des-Moines-IA-50311/808286\\_zpid/](https://www.zillow.com/homedetails/1317-57th-Pl-Des-Moines-IA-50311/808286_zpid/), accessed April 22, 2025.

The housing censuses show that basement living spaces were involved in another trend of US homes: the average residential space per person was increasing sharply. To be sure, this phenomenon resulted in significant part from a decrease in the number of people per household. The declining ratio of people to homes aligned with two downward trends: the decrease in multi-generational dwelling, which was codified by 1930s homeownership policy, and the falling national birthrate. In most urban areas, increases to housing supply outpaced population growth.<sup>763</sup> Detroit was a glaring example. In 1950, the city had eighteen percent more housing units than in 1940 but only fourteen percent more people. Over the next decade, Detroit added six percent more housing units—mostly located on the city’s fringe, as was true in the decade before, but Detroit’s population *fell* by nearly ten percent.<sup>764</sup> As a result, there was simply more square footage of housing available for each resident of Detroit. Nationally, the average occupancy rate fell by about one person per household, down to about 3.5 in 1960.

Other factors than demographics were at play. Builders also made new housing units larger even though fewer people resided in each, though this was another point of racialized inequality. Though the nonwhite US population increased by a few percentage points between 1940 and 1960, there was virtually no change in the ratio of white to nonwhite heads of households (~10:1). Absolute increase in nonwhite headed households was concentrated in existing housing stock of central cities, while white headed households disproportionately occupied the newer homes on metropolitan fringes that were more likely to contain added living space in the form of a concrete basement.<sup>765</sup>

One such fringe area was Chicago’s North Shore suburbs. There, builders erected thousands of homes in the postwar years. The new homes extended from lakefront municipalities like Evanston and Wilmette, where generations of homeowners had reaped the benefits of the city’s industry at a

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<sup>763</sup> Michael Haines, “Fertility and Mortality in the United States,” in Robert Whaples, ed., *EH.Net Encyclopedia*, Economic History Association, March 19, 2008, <https://eh.net/encyclopedia/fertility-and-mortality-in-the-united-states/>, accessed April 22, 2025.

<sup>764</sup> *1960 Housing Census*, xxii.

<sup>765</sup> *1960 Housing Census*, xxvi.

comfortable distance from the less desirable smells, sounds, and concentrated population.<sup>766</sup> In the 1940s, developers filled remaining lots in Chicago's northern fringe and Evanston, mostly with townhouses and apartment complexes.<sup>767</sup> Postwar, builders quickly turned inland, which included the Village of Skokie. The sprawling new subdivisions that followed facilitated a striking population change. The 1950 census counted some fifteen thousand Skokie residents, more than double the 1940 number. By 1960, the tally had vaulted to 60,000 inhabitants, the majority of whom lived in relatively new single-family homes. Over the same period, the rate of homeownership in Illinois increased from forty percent in 1940 to fifty percent in 1950 to fifty-eight percent in 1960.<sup>768</sup>

Homeownership rates were unevenly spread across racial and ethnic demographics. But while the lakefront North Shore suburbs had both legal ordinances and unspoken codes that reserved homeownership for white Christian families, Skokie quickly became known as a suburb where Jewish, Black, and Asian might purchase homes.<sup>769</sup> As the following case study will demonstrate, concrete basements were overwhelmingly a feature of Skokie's new homes, and that feature extended the area's longstanding practices of suburban separation into the domestic underground. Basements offered North Shore homeowners an experience of privacy, safety, and quiet that was no longer inherent to the aboveground landscape, which was quickly beginning to fill with people and automobiles. Of the many ways to convey this rapid filling of the inland North Shore, perhaps no event paints a better picture than

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<sup>766</sup> Mitman, *Breathing Space*, 3-4.

<sup>767</sup> Al Chase, "3½ Millions to Be Spent for Housing," *Chicago Daily Tribune*, January 25, 1948, NW8, viewed as item 2020.001.082 in the collections of the Skokie Heritage Museum.

<sup>768</sup> U.S. Census Bureau, "Homeownership Rates" [a decennial time series, by state], <https://www2.census.gov/programs-surveys/decennial/tables/time-series/coh-owner/owner-tab.txt>, accessed February 15, 2025.

<sup>769</sup> The relative religious, racial, and ethnic diversity of Skokie is evident from searching census records of the homeowners named on midcentury real estate listings. For a general history of Skokie, see Richard Whittingham, *Skokie, 1888–1988: A Centennial History* (Wilmette, IL: Raspail Productions, 1988), now made available at <http://skokiecentennialbook.com/> (accessed April 22, 2025) by the Skokie Public Library and the Skokie Historical Society. For the infamous case of how Skokie's strong Jewish community was subsequently targeted by self-proclaimed American Nazis, see Philippa Strum, *When the Nazis Came to Skokie: Freedom for Speech We Hate* (University Press of Kansas, 1999).

the October 1956 opening of Skokie's Old Orchard Shopping Center, to which thousands drove and then stood in a throng outside the anchoring Marshall Field's.<sup>770</sup> The half-mile-long mall, wedged between the newly completed Edens Expressway and US Highway 41, became the pre-eminent commercial district of the car-centric and thoroughly populated North Shore.<sup>771</sup>

Area home builder Irvin Blietz was prominent in developing Skokie basements. Blietz had discovered what would prove to be a diamond in the rough 1930s economy, successfully developing multiunit residential buildings on the city's far north side. In the 1940s, he turned most of his business away from city homes that derived value from proximity to the lake or train lines and toward the inland suburban tracts. On lots there, he built homes with abundant square footage, including sizeable basements, that were affordable to many in the upper half of Chicagoland's middle class. Basements became one knob with which developers like Blietz could fine-tune the initial cost of a midcentury home as they tried to optimize exclusivity, affordability, and profit. A single-family home three miles from the beaches and parks with a full basement fetched the same price as a lakeview townhouse with none.<sup>772</sup> Blietz played with this basement dial, turning it from concrete slab to partially excavated utility space to full underground living space. The landlocked Village of Skokie therefore hosted a high number of complete basements.

### Basements Across Skokie

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<sup>770</sup> "Vintage: Old Orchard Shopping Center," *The Chicago Tribune*, November 26, 2019, <https://www.chicagotribune.com/2019/11/26/vintage-old-orchard-shopping-center/>, accessed February 15, 2025.

<sup>771</sup> For more on the original Edens Expressway's role in altering Chicago's suburban development, see Edward Robert McClelland, "A Road by Any Other Name," *Chicago Magazine*, February 23, 2024, <https://www.chicagomag.com/city-life/a-road-by-any-other-name/>, accessed February 15, 2025.

<sup>772</sup> This conclusion is evidenced by a range of Skokie real estate listing cards shared among professional realtors and with the interested public. I translated much of that information into a spreadsheet that allows several comparisons of the uses and values of basements. The spreadsheet is available for viewing at [https://docs.google.com/spreadsheets/d/1uZidkOxZUE0QaOvC1wXTYlfsNtSMsCTgsEHn\\_MYYPXU/e/dit?usp=sharing](https://docs.google.com/spreadsheets/d/1uZidkOxZUE0QaOvC1wXTYlfsNtSMsCTgsEHn_MYYPXU/e/dit?usp=sharing) (accessed April 22, 2025).

In a sample of 92 real estate listings of both single-family homes and townhouses, built in Skokie between 1946 and 1962 and marketed between 1947 and 1976, 81 mentioned a basement.<sup>773</sup> Only two explicitly said the home had no basement. Nearly all basements matched the full footprint of the home. Skokie listing formats quickly changed in this period to allow more detailed description of homes, and realtors took advantage to name specific amenities contained within basements. Though an array of interior and exterior elements clearly affected a home's value, and most Skokie homes were consistently valued at two to three times the state median, greater extent and content of a basement generally translated to a higher selling price.<sup>774</sup> The bulk of the listings, dating to the mid-1970s, evidence how apparent retirees and empty nesters had maintained and upgraded the basement over the home's first decades of existence. Several ads touted the basement as remodeled or containing "newer" appliances. The Skokie real estate case study therefore provides strong evidence of the financial investment many Americans practiced in their basements. Details of the Skokie listings also anchor an exploration of widespread midcentury basement cultures.

### Socializing and Recreating in the 1950s Basement

Of the 81 Skokie homes that advertised basements, 65 named a recreation or family room. This was, as a rule, listed first when detailing basement features. The modern basement made possible a certain type of leisure and fun that was widely appealing in postwar America. Twelve of these had a fireplace, as

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<sup>773</sup> The 1960 housing census estimates of basements were published at the state level. Basement figures for the Chicago area, where sixty percent of Illinois' ten million residents lived, or even for all of Skokie reside in the gap between the state figures and what these archived real estate materials evidence. No doubt, basements were common in Skokie and in the Chicago suburbs generally even if they were less common than the archived real estate materials indicate. Of the 3,275,799 housing units in Illinois, just over half were owner-occupied and well over half were built since 1940. Seventy-eight percent, or 2,570,972 Illinois homes, had basements. The proportion was high relative to the United States but standard for the North Central region. See, *1960 Housing Census*, "Table 5.—Structural Characteristics and Heating Equipment, for the United States, by Regions, Divisions, and States: 1960—Con.," 1-18 to 1-21.

<sup>774</sup> U.S. Census Bureau, "Median Home Values: Unadjusted" [a decennial time series, by state], <https://www2.census.gov/programs-surveys/decennial/tables/time-series/coh-values/values-unadj.txt>, accessed April 22, 2025.

an embellishment rather than a primary heat source. In a few homes, the rec room space was separate from an additional play or game room. In many homes, it was clear the rec room was not only or even primarily for children's fun. Seventeen of the homes named a bar, either wet or dry, as a built-in component of this recreational space (Fig. 5.6). Eleven basements contained a refrigerator, four as part of a full kitchen. In 1960, under one in five US households had a single "home food freezer," yet six Skokie homes featured a second one in the basement.<sup>775</sup> Of the 43 with either a finished lavatory or roughed-in plumbing for the same, 15 also included a shower or tub. Only two with a full kitchen and a full bath were advertised as potential apartment spaces for live-in extended family, evidencing that such cohabitation was an uncommon vision for home basement space. As if the ideal social utility of these features were not clear enough, realtors added language like "perfect floor plan for gracious entertaining" or "a complete 2nd kitchen for parties, etc."<sup>776</sup>

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<sup>775</sup> 1960 Housing Census, *xxxix*.

<sup>776</sup> "Gracious entertaining" in listing for 9014 Tamaroa (1976?), viewed as item 1997.011.475 in the collections of the Skokie Heritage Museum; "Complete 2<sup>nd</sup> kitchen" in listing for 8734 Springfield (1976), item 1997.011.466, Skokie Heritage Museum.



Figure 5.6. In the 1970s, Section 21 of the Luxembourg Brotherhood of America met in the Wilmette, Illinois, basement of one member. The bar, often supplemented by a sink and sometimes even by the home's second refrigerator or freezer, was a locus of socialization. Image courtesy of the Wilmette Historical Museum.

Fully finished, electrified, and decorated basements were not only a venue for existing modes of recreation but a setting for new diversions. Among these, viewing television quickly proved to have a particular synergy with the domestic underground. Production of electronic televisions began in the years preceding the war, but sets were exceedingly rare in homes until the 1960s. Several factors including changes to manufacturing, greater consumer power, and general increase to leisure time kicked off a proliferation in the late 1940s. Still, in 1950 only about one in eight US households had a television. By 1960, the ratio had flipped. Seven in eight households, or 46.3 million homes, had at least one television, and of those about one in eight had *multiple* sets.<sup>777</sup>

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<sup>777</sup> 1960 Housing Census, xxxix.

In 1950, members of the West family of far west Philadelphia, were somewhat early though hardly unique in their television use. Using photographs as a guide, their basement included an upright piano and lamps for reading, yet the seating was arranged for television as the primary activity. The Wests used their basement television room to “take care of their children,” which apparently meant entertaining the kids while parents socialized upstairs—a familial segregation that would have been far more limited without the basement. To be sure, the adults also watched television, sometimes socially. John West appreciated that the home’s lot sloped such that his basement opened onto a back terrace, allowing him and his male friends to tend the grill while live sports played on TV with wives and children elsewhere. The fully finished basement television room was therefore a reversible space, alternately a place to tuck kids into and one in which to retreat from parenting responsibilities.<sup>778</sup>

Though the television only gradually took over the national entertainment landscape that had previously been dominated by public theaters and home radios, it colonized the basement swiftly in the 1950s (Fig. 5.7). As scholar of screen cultures Lynn Spiegel has documented, the basement was commonly the first place that Americans wanted to place a television within their homes.<sup>779</sup> The reasons may have been several. Certainly, the cemented underground space had natural darkness that made cathode-ray images more visible. In addition to excluding light, basements were physically separated from the rest of the house, even if they had become functionally integrated into everyday life. In the 1960s, Americans began placing televisions in more traditional living spaces including bedrooms and even kitchens, but the bright and noisy technology’s trial run occurred in more sequestered rooms. For those who had one, that typically meant the finished basement.

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<sup>778</sup> Margaret Gelbach, “Basement Television Room,” *Better Homes and Gardens* 29, no. 3 (November 1950): 242-243, WMA.

<sup>779</sup> Lynn Spiegel, *Make Room for TV: Television and the Family Ideal in Postwar America* (Chicago: University of Chicago Press, 1992), 37-38.



Figure 5.7. In 1957, the Allegretti family's newly remodeled basement in La Grange, Illinois, exemplified how the television had become central to practices of socializing and entertainment in the electrified, comfortable, cement-encased underground. HB-20511-E, Chicago History Museum, Hedrich-Blessing Collection.

### Mothering in the Midcentury Basement

In Skokie, a basement laundry area had become so common that forty-five listings did not bother naming its location in the home. In 1960, only two in five US households had a self-powered washing machine and fewer than one in five had an equivalent drying appliance.<sup>780</sup> The rates must have been higher all along in the fully electrified Skokie basements, and the more detailed 1960s and 1970s listings named both laundry appliances without fanfare. Regardless of the equipment, laundry remained an unmistakably gendered chore. It belonged to the continued development of American homemaking and

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<sup>780</sup> 1960 Housing census, *xxxix*.

mothering in the basement, which for some women was likely an unqualified burden though for others apparently offered some opportunity for niche creation by adding hobby elements added to these mundane tasks.

The middle-class trend away from hired or live-in help, already underway at the beginning of the century, was the new reality in the postwar years.<sup>781</sup> Even as basements became spaces for glitzier investments in modern living, many continued to host the fundamental work of managing children and cleaning a house (Fig. 5.8). That was one reason that midcentury mothers deemed the basement an ideal place for children to play. Children literally contained and protected in a basement recreation room were under mother's care well enough, whether she was downstairs interacting with them, doing laundry around the corner, or reading a magazine upstairs.<sup>782</sup>

Surprisingly, though, some mothers took pride in basements that were *not* lavishly finished living spaces because it showed where their priorities of motherhood and homemaking lay. In her 1948 article, "We Have a Basement Playground," Jean Reiman contrasted her basement with "those luscious creations complete with tiled floors and knotty-pine walls." Her humble basement was instead simply "whitewashed cement walls, furnace, coalbin, [and] concrete floor." She admitted that washdays, three times a week for her, had been "pretty grim" before her son, Billy, and daughter, Shari, were old enough to play without any supervision. In the basement with her, they would get into places they should not be, like the coalbin, and they constantly pulled Reiman away from the already tiring work of washing clothes with a wringer. Then, Reiman began gathering wooden apple boxes from her grocer and had her husband pick up mill ends and odd lengths of board from a lumberyard. With these simple objects, the family created bridges, slides, building blocks, a wagon, and even a sandbox. "Sweeping [the sand] up is a small job after the fun the children have playing there all morning," Reiman assured readers. She looked

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<sup>781</sup> Whitaker, "Basement Design," 87.

<sup>782</sup> For an example of spatial prescriptions for homemaking/mothering in the basement, see "Parents' Magazine Designs This Three-In-One Room Laundry--Playroom—Workshop," *Parents' Magazine & Family Home Guide* 31, no. 6 (June 1956): 57, 59-64, 66, WMA.

forward to washdays and less often had “a wrecked house to clean” now that the children expended energy and made their messes in the basement.<sup>783</sup>



Figure 5.8. These photos taken in December of 1957 and April of 1958 show the Evanston, Illinois, basement of Frank Nahser and his unnamed family members. The images illustrate not only the renovation but also the gendered distinction between the spruced-up laundry area and the new wall for organizing painting and carpentry tools. HB-21051-B and HB-21051-I, Chicago History Museum, Hedrich-Blessing Collection.

### Dads Build-out the Basement

In a typical arrangement of mother-and-father basement spaces (Fig. 5.8), seven Skokie basements featured a workshop for small carpentry projects, a potential means to further investments in the basements. Listings described six of the basement spaces as either partially or fully finished, meaning a layer of decorative, insulative, or otherwise more pleasant material covered the concrete walls and floors. Most had at least one room walled with a more richly textured material than the utilitarian boards of Masonite or gypsum advertised in the 1930s, though one used such walling as a base for murals that depicted farmyard scenes. Forty-nine, a healthy majority, had wood paneling in the rec room. These vertical wood slats, common in magazines’ featured basements since 1930 (Fig. 5.9), had developed into

<sup>783</sup> Jean Reiman, “We Have a Basement Playground: Easy-to-make Play Equipment in the Basement Makes Washday Happy for All Concerned,” *Better Homes and Gardens* 26, no. 5 (January 1948): 12, WMA.

a nonpareil for basement walling. Realtors described the wood finish in six basements as “beautiful.” Two basements were finished in cypress, one the texturally intriguing “pecky” variety. Another was “lovely knotty pine,” one walnut, and one cedar. Flooring finishes more often went unspecified, but one named vinyl and another tile and by the 1970s seven were carpeted, one “richly” so. Simply “finished” basements achieved only the minimum.



Figure 5.9. Wood paneling had been a component of the new basement recreation room ideal since its appearance in domestic magazines circa 1930. But as seen here, the water-sensitive paneling reached a new level in the 1960s. Author’s collage of images published with “Step by Step to a Finished Basement” in *Better Homes and Gardens* (November 1965), in the Proquest Women’s Magazine Archive.

The superficial elements of a basement were valuable selling points and at the same time easily changed attributes. In the postwar years, basements became a prime venue for the home improvement projects that increasingly characterized a father’s role in many nuclear families. In 1949, a New York architecture firm gave dads across the country twelve suggestions to “fix up your basement.”<sup>784</sup> Even the most technical suggestions bled into notions of improving the quality of home life for wife and kids, a similarity between fathers’ and mothers’ expected basement roles despite the sharp distinctions between building and cleaning.

<sup>784</sup> Joseph B. Mason, “12 Ways to Fix Up Your Basement: Make Your Basement Light, Warm, and Dry,” *Good Housekeeping* 128, no. 1 (January 1949): 68-70, WMA.

When the architects recommended a door directly to the outside in part for “better ventilation,” the accompanying image showed rubber boots, galoshes, and rain jackets organized neatly by the new entrance. Their various sizes represented the nuclear family, while their presence demonstrated that basements regularly spanned the indoor-outdoor divide in their uses. Among several suggested improvements specifically for children were a wall of cabinets for toys and games, a pull-down movie screen, a “junior library” of chalkboards and bookcases, and a “rainy-day gym” that contained a miniature swing set and a suspended punching bag. Other touted basement upgrades, like a “garden room” where plant starts took in natural light above a bench designed for potting and a “paint shop” that included racks for drying brushes and drop cloths, were meant to themselves aid other house projects. Another of these, the basement workbench, had a second seat for a young helper on dad’s home improvement efforts.<sup>785</sup> The father-son activity of basement carpentry quickly became salient enough as a wholesome representation of home life that industry deployed it in national advertisements.<sup>786</sup>

Echoing the 1930s American Radiator Company’s renovation contest that highlighted cement underpinnings, some postwar basement fix-up suggestions addressed the concrete structures that made these underground improvements possible. Other experts extolled new radiant heating systems. Installing one would likely involve hiring a contractor capable of pouring an additional slab of concrete that was embedded with pipes connected to the home’s water heater. The rationale for such an investment included more nods to parenting. For instance, radiant heat turned the cold concrete floor into a surface “cozy enough for the baby to romp on safely.”<sup>787</sup> Yet many experts advised an additional layer of concrete without heating pipes, simply to increase the basement’s waterproofing. Keeping the basement dry now

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<sup>785</sup> “Try these Ideas in Your Basement: A Lot of Fun – Some Really Useful Storage Pleasant Surroundings a New Area of Livability All This Exists in Nearly Everybody’s Basement. Work Out Your Plan to Take Fullest Advantage of the Space You Have Then Let Yourself Go with Hammer and Saw on a Worthwhile You-do-it Project around the Home,” *Better Homes and Gardens* 33, no. 2 (February 1955): 67-67, 157, WMA.

<sup>786</sup> Timothy J. LeCain, *Mass Destruction: The Men and Giant Mines That Wired America and Scarred the Planet* (Rutgers University Press, 2009), 196.

<sup>787</sup> Mason, “12 Ways to Fix Up Your Basement,” 68-70.

explicitly meant safeguarding the family's subterranean space as a warm, safe, insulated retreat from the outside world.

The same year, steel salesman Myron Eichengreen of Wilmette, Illinois, shared how, when his wife had been pregnant with their second child, he began to envision his home's existing concrete foundation with its brick fireplace and steel casement windows as the kernels from which to build out a new combination recreation/guest room. Eichengreen was an amateur and yet he had completed the job mostly alone in under six months, "working only a few evenings a week." A ventilating fan next to the clothes dryer and a vapor barrier made sure no condensation developed on the new paneled walls. New wiring was hidden by a drop ceiling of rose-gray composition board above, and the floor below was now tiled with brown asphalt squares. He did hire out the installation of new heating ducts. When they were not hosting visitors, the space served as a quiet space for individual escape or a fun location for "barbecue dinners served around the inviting hearth." Myron had since installed a television set and, his children now approaching elementary school age, turned to imagining how "neighborhood youngsters" could bring their messes down there instead of into the living room.<sup>788</sup>

To return again to Zip Zeller's home in Des Moines, it is now more clear that he offered another example of dad's building out the basement and giving the family home a new dimension. The Zellers' house had less than 1,200 square feet of aboveground living space, typical of many homes constructed between the war's end and 1950. However, as the 1957 *Bettors Homes and Gardens* feature showed, Zip had expanded the Zeller's livable interior by collaborating with the lower level's walls of concrete block masonry and its solidly cemented floor. Combining his own skills of craftsmanship with an array of affordable building materials, Zip created separate spaces for the entire family. For children Nancy and

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<sup>788</sup> "You Can Make the Basement More Usable: Faced with the Necessity for Additional Living Quarters, the Eichengreens Converted their Basement into this Usable Room!," *Parents' Magazine* 36, no. 1 (January 1949): 44, WMA. Family member information with "Myron H Eichengreen" in U.S. Census Bureau, *Seventeenth Census of the United States, 1950*, Wilmette, Cook, Illinois, Enumeration District 16-490, Sheet 3, Line 7, accessed via Ancestry Library Edition.

Bonnie, he built a recreation room that was fully finished with wood paneling and bookshelves. For wife Clara, he designed and constructed a “laundry-utility center.” Magnanimously, he took for his own space only an eight-by-ten-foot nook behind the furnace. Still, by maximizing vertical storage, Zip fit a fully stocked workshop: bench, hand tools, a drill press, and various containers of nails, screws, and washers stacked from floor to ceiling.<sup>789</sup> Here, Zip was able to continue working with his hands as a balance to what his managerial job at Foxbilt Feeds likely entailed.

The same *Better Homes and Gardens* issue with Zip’s handiwork featured two other single-family home basements. “Ideas for a Basement Fun Room” presented an anonymous exemplar space with wood-paneled walls, a built-in entertainment center for TV and music, and storage for games and books. Crisp lines and clean white surfaces lent a coherent modernism to everything from countertops to the sectional couch.<sup>790</sup> “New Home in the Basement” featured the Tacoma, Washington, abode of Robert Price and family. Faux brick facing, plywood built-ins, and carpet covered the basement’s cement surfaces completely to make a cozy space for reading, sewing, and other hobbies.<sup>791</sup> The Prices, *Better Homes and Gardens* contended, demonstrated economy by turning their downstairs into “a new center for family activity.” Homeowners have paid for their basement spaces, pointed out the periodical’s editor, referring to the literally and figuratively sunken costs of the cement-sealed underground. “Why not, then, make it pay its way?”<sup>792</sup> For fathers—usually responsible for both the physical construction of a household and overseeing the house’s role in family finances, building out the basement was an important task that often realized the space’s potential for unproductive fun.

#### Stuff & Storage in the 1950s Basement

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<sup>789</sup> “Small Workshop with Big Ideas,” *Better Homes and Gardens* 35, no. 4 (April 1957): 86-89, WMA.

<sup>790</sup> “Ideas for a Basement Fun Room,” *Better Homes and Gardens* 35, no. 4 (April 1957): 216, WMA.

<sup>791</sup> Two of the sampled Skokie real estate listings (Unit C and Unit D at 4712 Washington Street) also advertised faux brick as a basement walling material.

<sup>792</sup> “New Home in the Basement,” *Better Homes and Gardens* 35, no. 4 (April 1957): 339, 350-351, WMA.

Forty-five of the Skokie listings made some mention of basement storage, many with modifiers of abundance like “huge” or “loads of.” On the one hand, basements simply echoed general emphasis on storage. Any given listing likely advertised a garage, a shed, or a walk-in master closet. On the other, the basement was clearly preferred for long-term storage of specific items like clothing. Ten of the basements sold in the mid-1970s featured closets of cedar, a material with dehumidification properties that supplemented cement’s control of underground moisture while adding moth deterrence for fabric preservation.<sup>793</sup> Cedar, while functional in these specific ways, also provided a desired appearance that clearly enhanced basement value, as opposed to new polyethylene films that were also used to keep basement storage items dry and moth-free.<sup>794</sup>

Storage was not at all a new use of space beneath a home, but forms of storage in the modern basement differed from those in the old cellar. Exclusion of water as well as organisms and other natural elements meant homeowners could now confidently fill the spaces with objects that tended to be more delicate, more luxurious, or more decorative. Among these were seasonal-use items like cushions for patio furniture, purchased in northern states with the understanding that they would be stored for at least several months in each year.<sup>795</sup> The 1948 *Bettors Homes and Gardens* article “What? No Basement?” dramatized the case of homeowner Walter Whitney, who wished for a basement to store “incidentals.” His garage space barely accommodated his car, and his utility room was likewise at capacity with its appliances. Whitney had developed numerous hobbies and home maintenance practices, particularly in lawn and garden management, that required a plethora of items. He was sure that these items, in storage

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<sup>793</sup> Cedar odor had long been understood to repel moths. See, for example, an advertisement for “Slip-In Garment Bags,” *Good Housekeeping* 90, no. 5 (May 1930): 228, WMA.

<sup>794</sup> Bob Gilmore, “New Tricks with Sheet Plastic,” *Better Homes and Gardens* 37, no. 8 (August 1959): 16, 18, WMA.

<sup>795</sup> Whitaker, “Basement Design,” 91; One commonly advised basement element was a rack that allowed for storing luggage or a rotating cast of items like summer-only patio cushions and winter-only storm windows, without any of those things touching the basement floor.

far more often than they were in use, were best maintained by keeping them in the clean and dry basement environment that his home lacked.<sup>796</sup>

In 1954, *Better Homes and Gardens* investigated the burning question of “Basement or No Basement?” Staff writer Curtiss Anderson summarized the findings. Concerns about maximizing living space on a small lot or increasing resale value pointed to yes, basement. Moreover, Anderson pointed out, “People live in basements. Women do laundry in basements. Children play in basements. Handymen work in basements. Families have parties in basements. Scooters and [window] screens, furniture and food, tools and toys, boxes and bicycles are stored in basements.” Why, he asked, were architects designing any homes without them?<sup>797</sup>

Anderson went on to answer his own question, detailing the reasons for forgoing basement construction that the investigation had yielded. There were plenty. Despite labor-saving excavation equipment and mixer trucks, some homeowners still could not afford a full basement. Others simply did not need the space or, if they did, their lots were large enough that it could be more cheaply built horizontally, above ground. Many others lived in some combination of terrain and climate that inhibited basement construction. Despite the widely known and, among a section of Americans, commonly practiced cultures of modern basement living, the basement was not an absolute necessity.

Anderson also noted more of a problem than a solution in the basement’s potential for sound, indefinite storage. They decried basement storage space as an excess that simply invited further excesses. “Basements are catchalls for things that you should have thrown out in the first place,” he wrote. By the decade’s end, basement storage was involved in a novel and widely recognized modern problem of accumulated belongings. A 1960 article on storage asked readers, “Is your garage or basement

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<sup>796</sup> Walter R. Whitney, “What? No Basement?: Where Then, Wails This Frustrated Homeowner Who Has No Basement Himself, Are You Going to Put Things? His Tale is Worth Your Thought,” *Better Homes and Gardens* 27, no. 3 (November 1948): 37, 162-164, WMA.

<sup>797</sup> Curtiss Anderson, “Basement or No Basement?,” *Better Homes and Gardens* (October 1954): 154-157, WMA.

overflowing with the ‘indispensable’ junk necessary for maintaining a household? Do you find yourself moving pyramids of boxes to get one thing—always at the bottom?”<sup>798</sup> Those answering affirmatively were mostly advised to further build out their basements, despite the writer’s decluttering suggestion, hardly subtle in the phrase “*indispensable*” *junk*. Assuming homeowners would deem much matter worth saving, they needed to organize it on shelves and within cabinetry. Cultures of basement storage therefore had layers of investment, one involving the items retained for occasional functions around the home and one involving the structures that made such items findable when needed.

### Surviving in the Basement

In the 1950s, an influential contingent of Americans deemed home basements crucial to surviving the Soviet nuclear attack that often seemed imminent. Through federal nuclear preparedness plans, the safety, isolation, and stability that many newly middle-class Americans had experienced in environments beneath their homes surely helped fuel new views of basements as impregnable fortresses that would save American families, both informing government policies and complicating popular attitudes toward safety. President Dwight D. Eisenhower’s Science Advisory Committee, working toward what would become known as the Gaither Report, considered programs for a system of public bomb and fall out shelters across the country.

Citing a list of considerations that included finances and military preferences as well as predictions of public backlash against communal sheltering, the committee instead went with the tide by which private houses and basements in particular were pulling American culture into radical individualism. Eisenhower’s National Shelter Policy of 1958 became, as historian of postwar civilian life Laura McAneny put it, “a reorganization of civil defense that finally codified the family shelter as the

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<sup>798</sup> “Garage Storage: ...It Works in the Basement, Too,” *Better Homes and Gardens* 38, no. 7 (July 1960): 93-94, WMA.

centerpiece of preparedness.”<sup>799</sup> Office of Civil and Defense Mobilization (OCDM) director Leo Heogh concluded a civil defense film by claiming “no home in America is modern without a fallout shelter; this is the nuclear age.”<sup>800</sup> In official public messaging, OCDM and coordinating agencies depicted a default identity of national citizens as white, middle-class owners of a single-family home with basement.<sup>801</sup> This select group received outsized recognition and political importance in the Cold War.



Figure 5.10. A demonstration basement fallout shelter prepared by the Office of Civil Defense Mobilization amounted to a second foundation wall of concrete blocks and cement mortar that connected to the existing foundation walls. The image gives a sense of why most American homeowners with a

<sup>799</sup> Laura McEnaney, *Civil Defense Begins at Home: Militarization Meets Everyday Life in the Fifties* (Princeton, NJ: Princeton University Press, 2000), 57-58. See also: Kenneth D. Rose, *One Nation Underground: The Fallout Shelter in American Culture* (New York University Press, 2001), one of several books that investigate the rich topic of American civil defense policy, in which Cold War volatility intertwined with powerful dynamics of nationalism, consumerism, and civil rights in the postwar U.S.

<sup>800</sup> David Monteyne, *Fallout Shelter: Designing for Civil Defense in the Cold War* (Minneapolis: University of Minnesota Press, 2011), 15.

<sup>801</sup> Monteyne, *Fallout Shelter*, 29-30.

basement decided that the concrete foundation walls they already had would sufficiently protect their families.

Ideal implementation of OCDM's preparedness vision would have entailed construction of a fairly elaborate concrete block bunker room within each American family's basement (Fig. 5.10). However, while this may have been the ideal, the actual preparedness that Americans achieved fell well short. One problem was that nearly two in five heads of household were not homeowners and therefore needed a landlord to approve if not initiate shelter construction.<sup>802</sup> Another was that plenty of homeowners could not afford constructing a concrete block bunker. For that, the Eisenhower administration offered some subsidies or credits. These did not spur ubiquitous bunker building, perhaps indicating that those who had home basements trusted the existing concrete to provide safety. A third problem was that while concrete bunkers could be built above ground, official advice made clear that the safest shelter location was underground. Yet nearly half of Americans had no basement at all under their homes. Even among homeowners with a basement, relatively few made the expenditures and efforts needed for a true bomb shelter.<sup>803</sup>

Nonetheless, the idea that belowground living spaces could be family saviors proliferated in the American imagination. In 1959, Mordecai Roshwald published *Level 7*, a dystopian science fiction novel set in a future where humans had nearly been annihilated by sudden nuclear war. The only people spared were those residing in an underground fortress at the time of mass detonations. This building extended from the surface some four thousand feet underground. At the bottom, the eponymous Level 7, was a chamber for military officials. The entire space was temperature-controlled, had the perfect amount of artificial lighting, and contained provisions enough to keep its inhabitants alive for five centuries. Though the structure's dimensions, of course, had no real-world corollary, imagining such a complex was certainly advanced by the ubiquity of poured concrete foundations. *Level 7* took place in a literally

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<sup>802</sup> 1960 *Housing Census*, xxvi.

<sup>803</sup> McEnaney, *Civil Defense Begins at Home*, 59-63.

fantastic basement home, but it represented many Americans' expectations that their own basements would help them survive nuclear war. The book was a hit, quickly reprinted in subsequent years.<sup>804</sup>

Among several new questions that the 1960 housing census posed regarding home amenities, presumably added in part due to new civil defense concerns, one asked whether a basement existed in the housing structure. The results revealed an American housing reality with somewhat contradictory implications for the OCDM's basement bunker ideal. Basements existed under some 31.5 million homes in the United States, a figure well above the 7.4 million built upon a concrete slab and more than the 19.4 million lumped into an "Other" category that included crawl spaces, elevated pilings, and homes "directly on the ground." Yet the homes with a basement below were only a little more than half of the nation's 58.3 million housing units. Furthermore, positive responses included apartments in buildings with a shared basement. The 36.4 million homes in metropolitan areas were far more likely built atop basements than their 21.9 million rural counterparts. The census also confirmed a regional disparity previously insinuated by the architectural and domestic publications that had featured basements primarily located between Iowa and Long Island. Seventy-four percent of housing units in the North Central region had a basement. In the Northeast, eighty-nine percent did. In the South, a strong majority were "Other" and only one in five had a basement. The only notably pattern within the varying landscapes of the final region, the West, was that nearly one quarter of homes sat on a concrete slab—nearly as many as had basements.<sup>805</sup>

Safety and comfort provided by existing poured concrete and finished basements helps explain both the outsized influence of the home basement on civil preparedness plans and the underwhelming construction of distinct bomb shelters. McEnaney notes many factors that may have contributed to civil defense lethargy. One was simply the popular trust that an imposing U.S. military would deter and defend against nuclear war. Another factor, in which basements appear to have been involved, was a common belief, augmented by commercial marketing, that sufficient preparedness could mean going about an ideal

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<sup>804</sup> Mordecai Roshwald, *Level 7* (New York: McGraw-Hill, 1959).

<sup>805</sup> 1960 Housing Census, xxxv.

American domestic life. McEnaney dubs much of this “atomic housewifery,” seen in the discursive militarization of cleaning, cooking, child-rearing, and consumption that defined feminine domesticity in the early Cold War.<sup>806</sup> Concerned about biological warfare or food supply sabotage, housewives heard and spread advice to cook meals properly. Keeping homes dirt-free, and therefore germ-free, was imperative for the health of the nation.<sup>807</sup> To that end, pre-existing products and practices of home sanitation lent a sense of security that perhaps diminished interest in complete remodeling of home life. Basement structures were now well established as directly contributing to the home’s order and cleanliness and indirectly doing so via the materials, appliances, and practices that they hosted. Basements thereby captured American imaginations of preparedness and led many to believe that digging into existing cultures of underground life would sufficiently protect their families.

Belief in the inherent safety of ideal American domestic life was evident as basement shelter preparedness continued to spread throughout the country. In December of 1961, *The Montana Farmer-Stockman*, a periodical primarily for rural readers, published several letters from readers that exemplify the phenomenal trust in basements.<sup>808</sup> Four contributors from around the state opined in response to a prompt asking, “Have you thought about personal survival in the event of a thermonuclear war?” The editor, Amy Martin, had solicited thoughts on “a home fallout shelter, if you keep a food supply on hand, and what other plans you might have made.”<sup>809</sup> There was no need to describe the geopolitical context that precipitated these questions. The Soviets had nuclear warheads and, thanks in part to Gaither Report errors, many thought hundreds of those weapons could be used on American soil. One published letter came from Phyllis Adolph.<sup>810</sup> Under the title “We Should Make Some Preparation,” Mrs. Adolph wrote

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<sup>806</sup> McEnaney, *Civil Defense*, 108.

<sup>807</sup> McEnaney, *Civil Defense*, 110.

<sup>808</sup> “Your Letters,” *Montana Farmer-Stockman* [Great Falls], December 1, 1961, 25, CA.

<sup>809</sup> “Your Letters,” *Montana Farmer-Stockman* [Great Falls], November 1, 1961, 24, CA.

<sup>810</sup> Named only by her husband’s name in the *Farmer-Stockman*, the first name was found in Montana Department of Public Health and Human Services, *Montana Death Records 2017*, Cheryl Tomassi, “Phyllis Jean Adolph,” 201733-009145, November 24, 2017, accessed via Ancestry Library Edition.

that each family unit was responsible to prepare for its own survival, and preparation meant a family fallout shelter. She warned her neighbors that rather than feeling too secure they should “remember December 7, 1941.”

Though Mrs. Adolph’s sentiments of private responsibility aligned with the 1958 federal shelter policy, her definition of an acceptable “fallout shelter” did not. She assumed a wide range of underground havens were satisfactory. Adolph declared her “remodeled basement [was] well equipped” thanks to an old cook stove, table and chairs, weeks’ worth of stored food, and more. Even if other rural Montanans did not have a remodeled basement, she claimed they all would have some underground room—even a root cellar would suffice. Mrs. Adolph went so far as calling out those “rich and stupid” people she had heard were spending thousands of dollars to build a new, task-specific concrete shelter.

Another respondent, identified only as Mrs. A.J.H., obviously agreed that being underground with supplies was all that mattered. For only one hundred and sixty-eight dollars, her family had turned its well house into a shelter she deemed serviceable. For preserving the supplies, Mrs. A.J.H. got resourceful. “We put everything in 4-lb. coffee cans,” she explained, “or the empty plastic bags from buttermilk bread.” The cans and bags separated emergency sweaters, towels, and baking supplies from the surrounding earth. However, she admitted that moisture, dirt, pests, and odors from the adjacent soil constantly threatened to compromise her careful fallout preparations.

By contrast, it is safe to assume that Mrs. Adolph’s basement furniture was not covered in bread bags. Instead, nearly the entire underground space was encased in cement, a material that kept unwanted subsurface elements from penetrating. Cement made walls and floors impermeable enough that the underground space within them became more than sufficient protection for supplies; it was also an appealing place to spend time. Cement was an aid to many women’s atomic housewifery by creating a space in which the family, with its stash of clothes, food, and board games, could supposedly survive the most ferocious weapons on earth.

Historian of Cold War cultures Thomas Bishop finds the basement was also an incubator for specific paternal ideals. Already prone to building out their basements in ways that provided day-to-day comforts and joys to their families, fathers could now develop the space to assure the family's very survival.<sup>811</sup> Bishop notes a fleeting 1961 explosion of interest in prefabricated or kit family shelters, aided by President Kennedy's renewed emphasis on private home preparedness. These bunkers, some with cute anodyne names like "Kiddie Kokoon," others easily available at Sears, were a commercial product that served as a male corollary to the cleaning products sold to atomic housewives. The units could be erected in back yards, but theoretically a subterranean location was optimal. This quickly led to a host of issues, headlined by unfortunate homeowner discoveries ranging from old cellars that did not accommodate seven-foot-high shelter walls to surprise encounters with southern Florida's shallow groundwater.<sup>812</sup> Even in places like Chicagoland with its new, largely basement-having housing stock, the prefab shelter business was short-lived. Its failure demonstrated that an overwhelming majority of homeowners found standard, bunker-less basements safe enough, or perhaps simply realized that any shelter was unlikely to stand up against a direct nuclear blast.

Indeed, the sufficiency of home basement shelter plans came under scrutiny in the early 1960s. Some called the plan to shelter privately by family a morally insufficient national response. This problem was highlighted in popular magazines. The 1961 *Life* article "How You Can Survive Fallout" revealed how contentious the question of individual versus collective sheltering had become.<sup>813</sup> A vocal minority of homeowners who had invested heavily in shelters announced they had also stockpiled weapons for holding less prepared neighbors at bay when the civil defense sirens sounded. Many moral leaders were appalled, and several pastors and priests published rebuttals in a *Time* religion column. They all answered

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<sup>811</sup> Thomas Bishop, *Every Home a Fortress: Cold War Fatherhood and the Family Fallout Shelter* (University of Massachusetts Press, 2020).

<sup>812</sup> Thomas Bishop, "The Struggle to Sell Survival: Family Fallout Shelters and the Limits of Consumer Citizenship," *Modern American History* 2, no. 2 (2019): 117-138.

<sup>813</sup> Monteyne, 35-36.

“no” to the column’s titular question: “Gun Thy Neighbor?” But the column also quoted homeowners who were not swayed. One said of his shelter’s four-inch-thick wooden door, “This isn’t to keep radiation out, it’s to keep people out.”<sup>814</sup>

Others did worry more about the radiation component in nuclear scenarios, and they questioned whether a few inches of material, whether wood or concrete, was barrier enough. A 1962 article in the Toronto-based *Chatelaine* began with the question “Can you Protect Your Family from the Bomb?” and raised another, even more blunt challenge: “Are fallout shelters any good?”<sup>815</sup> Statistical estimates said that a fully concrete “Survival House,” promoted by the Portland Cement Association but rarely executed under homes, could be advantageous.<sup>816</sup> And one homeowner who went to the extreme of building a windowless concrete silo might have been right to call that structure “a hug” that could protect against a blast coming from any direction.<sup>817</sup> However, most home “shelters” were little more than standard basements that sufficiently excluded water, rats, dirt, but remained untested for their exclusion of radioactive particles. That question had begun garnering widespread attention. The bomb, understood circa 1950 as a threat to level or burn homes, was now more commonly understood as a source of dangerous and lingering fallout. Basement living was attractive enough that American survival plans had remained figuratively stuck in the space even as popular conception of nuclear disaster began to change. In the 1960s, many Americans remained attracted to basement life, but fewer trusted the cemented underground to save their lives.

#### Cracks in the Safe Basement

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<sup>814</sup> “Religion: Gun Thy Neighbor?,” *Time*, August 18, 1961, <https://content.time.com/time/subscriber/article/0,33009,872694-1,00.html>.

<sup>815</sup> Christina McCall Newman, “Can You Protect Your Family from the Bomb?” *Chatelaine* 35, no. 4 (April 1962): 29-31, 77, 79-81, 83-84, WMA.

<sup>816</sup> Monteyne, 117.

<sup>817</sup> Monteyne, 125.

The two decades that followed the peak discussion of basement fallout shelters brought increased attention to cement's limits and, therefore, to the liabilities of investing heavily in modern basement living. The National Flood Insurance Act of 1968 was a crystallization of national worries about home inundation. In the mid-1980s, the much more sudden awareness of radon as a threat to home health incited hasty changes to state laws and real estate practices. Neither environmental issue was confined to basement spaces, but in practice those who had basements worried more about how flooding and radon affected their homes. Each was a case of basement cultures facing regional threats, either of hydrology or mineralogy, in which the limit of cement's barrier capabilities became clear. Floods showed not only imperfections in the seals of individual basement structures but also the unavoidable truth that a basement could not be entirely sealed and remain a functional living space. Radon showed how that same liability of necessary openings in the basement could combine with cement's relative impermeability and concrete's tendency to crack under tension to admit a dangerous airborne material at a rate faster than it could be shed from the space.

In the 1970s, Skokie real estate listings began to include a disclaimer: "Flood Hazard Insurance may be required by Lender." New listing cards included the phrase as a standard potential attribute of the home, while old stock had to be modified with a rubber-stamped sentence when applicable. The North Shore's interior, like almost all of Chicagoland, had been a lowland network of slow-moving rivers and marshes since well before American appropriation and likely since the last glacial maximum. The potential for minor, seasonal flooding was not new. What was new included both the amount of water-sensitive investment in underground residential space and the potential requirement of flood insurance in order to receive a federally backed home loan. The National Flood Insurance Act of 1968—the result of two decades of federal political efforts that reflected lawmakers' interest in maintaining Americans' confidence in home values regardless of local environmental threats—had led to the National Flood Insurance Program (NFIP). The NFIP had a complicated relationship with modern basement investments. The program did not necessarily apply to all homes threatened by water intrusion. Despite the disclaimer

on Skokie listings, lenders did not require flood insurance for any home purchases in Skokie. The NFIP was not a distinct landmark in the history of cemented basements. Rather, the federal action reflected widespread flood consciousness that constituted a significant way that many American homeowners conceived of and related to their living spaces. The NFIP story also offers insights into how water affected fully modern basements.

Flood insurance was not a remedy for any water damage to basements. It was a specific financial product for specific results of weather events. Flood policies were (and are) necessary in the U.S. because homeowner's insurance did not cover flooding, though it covered other disaster damage including fire and wind. The policies took effect only when a precipitation event led directly to flow or accumulation of water in areas that were usually dry, a circumstance generally recorded by a residual high-water line. That captured some cases of water damage to U.S. basements, but it excluded others including the results of gradual seepage from surrounding soil. More complication existed within flood policies, which covered cleaning up basements and replacing or repairing structural elements of the house but were quite limited on basement contents. Utility elements such as furnaces and laundry appliances were largely insured by flood policies, but neither the superficial walls, floors, and ceilings of finished basements nor the personal contents that turned those rooms into amenities of comfortable living could be replaced with NFIP funds.<sup>818</sup> Any property owner could buy a qualifying flood policy and the program's insurance model benefited from voluntary participation, so these terms and conditions may help explain why the NFIP struggled to sign up homeowners beyond the mandatory participants who purchased homes within a "regulatory floodplain" or another "Special Flood Hazard Area." Barring a large weather event that caused uniform and total basement inundation, basic homeowners insurance was more helpful than a flood policy was for addressing soggy carpet or damaged floor tiles in a basement.

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<sup>818</sup> U.S. Department of Homeland Security, Federal Emergency Management Agency, "Fact Sheet: Myths and Facts About Flood Insurance," Press Release DR-4421-IA FS 016, June 11, 2019, <https://www.fema.gov/press-release/20230425/fact-sheet-myths-and-facts-about-flood-insurance>, updated April 25, 2023, accessed March 8, 2025.

The NFIP did provide limited help for maintaining a home with a modern cemented basement. Homeowners had long since realized that a basement with both floors and walls of solid concrete did not drain and dry on its own. Cement increased the chances that a flood would leave standing water under the home wooden framework, a circumstance that fostered fungal growth and generated “rot in a comparatively short time.”<sup>819</sup> Undrained water also created potential for costly damage to the foundation itself. Some of this liability to cement could be overcome with simple perforated iron floor drains, set within concrete that had been slightly graded to send water toward the drain points. Floors could also send water toward cement-walled pits from which it was pumped up and out through a hose or pipe by “an electrically driven unit which operates automatically.”<sup>820</sup> These submersible sump pumps had been commercially available since the 1920s, but their application proliferated in the postwar housing boom.<sup>821</sup>

In the event of a major flood, basement floor drains were liable to clog and electric sump pumps were rendered useless. One 1937 article on waterproofing the basement ended with a disclaimer that the “foregoing precautions” were worthless in the event that flows overtopped foundation walls. “That kind of water condition is technically known as a flood,” the authors wrote dryly. Their only suggestion then was to take your family to the attic with “a couple decks of cards.” Once the water subsided, they advised to “call the fire department to pump out the residue in the gameroom.”<sup>822</sup> With the NFIP, the fire department was off the hook. Homeowners with a flood policy were to call on a budding selection of specialist contractors who would either remediate the basement environment before damage to structure and utilities ensued or address any such damages. Then, those homeowners were to submit a claim for federal NFIP benefits.

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<sup>819</sup> Johnstone et al., 87.

<sup>820</sup> Johnstone et al., 86.

<sup>821</sup> This is reflected in the Google ngram returns for the phrase “sump pump,” which show two major spikes in usage between 1940 and 1960. See [https://books.google.com/ngrams/graph?content=%22sump+pump%22&year\\_start=1800&year\\_end=2019&corpus=en-2019&smoothing=3](https://books.google.com/ngrams/graph?content=%22sump+pump%22&year_start=1800&year_end=2019&corpus=en-2019&smoothing=3), accessed April 22, 2025.

<sup>822</sup> Sigman & Ward, 107.

A second category of homeowners stood to benefit from the NFIP for reasons beyond basement management. In their account of U.S. flood policy, historian of disaster Scott Gabriel Knowles and hazard economist Howard C. Kunreuther demonstrate that it was major events like the Alaska earthquake of 1964 and Hurricane Betsy in 1965 that impelled Congress to act decisively toward new financing of post-disaster relief.<sup>823</sup> The 9.2-magnitude quake generated stories-tall tsunamis that killed dozens while leveling several coastal towns south of Anchorage. Betsy's combination of surging tide and rainfall inundated communities from the Florida Keys to Arkansas. In New Orleans' Lower Ninth Ward, stormwater covered entire homes and drowned any residents who had become trapped inside after following the popular advice and heading to the attic. Catastrophic images of freak hydrologic events threatening people and their entire homes compelled Congress to pass the 1968 Act. Simultaneously, staggering numbers of Americans were moving to a hurricane-prone urban constellation anchored by Houston, Miami, and Hampton Roads. Most flood insurance policies in the Southeast did not involve basements, because that region had the lowest frequency of residential basements in the country.

A third category of homeowners, those concerned about periodically wet basements but not exposed to the type of events the NFIP most clearly addressed, were also part of the flood consciousness landscape. Development of new suburban homes with significant underground investments contributed to the nation's increasing proneness to residential water damage. The Skokie case provides an example. The NFIP did not deem any land in Skokie a Special Flood Hazard Area, but that did not stop water from threatening basements during and after periods of concentrated rainfall.<sup>824</sup> Skokie's infrastructure exacerbated this threat for multiple reasons. Stormwater collector pipes doubled as the Village sewage system and relied on discharge into an open channel connected to Lake Michigan for handling large

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<sup>823</sup> Scott Gabriel Knowles and Howard C. Kunreuther, "Troubled Waters: The National Flood Insurance Program in Historical Perspective," *Journal of Policy History* 26, no. 3 (2014): 327–53.

<sup>824</sup> Federal Emergency Management Agency, US Department of Homeland Security, "Flood Map 17031C0265J," *Flood Map Service Center*, <https://msc.fema.gov/portal/search?AddressQuery=village%20of%20skokie>, accessed March 8, 2025.

events. Furthermore, the main pipes had been constructed in the 1920s during an initial wave of residential development, modest in comparison to the transformations that had followed the Second World War. That massive population increase had elevated sewage flows and the associated development had blanketed surfaces with cement and asphalt that decreased rain infiltration.<sup>825</sup> By the early 1980s, flooding concerns had generated enough attention that village officials designated a Storm Water Relief Task Force. The group's initial product was a recommendation to overhaul the sewer system at an estimated cost more than five times Skokie's annual budget at the time. Lacking that cash, the municipality began instead investing time and human resources in the form of a decades-long project to disconnect downspouts, change street grades, and remodel sewer intake systems to prevent back-ups. These alterations to stormwater flow served to protect basement spaces and the practices of living and storage that those spaces hosted. The Village's toolkit included a program of ordinances and education designed in consultation with an environmental engineering firm.<sup>826</sup>

While Knowles and Kunreuther recognized suburbanization as important context for the 1968 Act, no historians have specifically acknowledged that U.S. basements, increasingly cement-sealed containers of socially and financially valuable material, constituted a thread that variously paralleled, contributed to, and diverged from National Flood Insurance Program history. Considering basement cultures in the context of flood consciousness highlights the limits of cement's ability to protect home investments. Basements could not be completely sealed and remain accessible, livable spaces. And so, even the best-made basements had routes of potential water entry. Yet cement was impermeable enough to

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<sup>825</sup> "Skokie's First Housing Boom" and "After World War II," in Skokie Public Library, *At Home in Skokie*, <https://skokiehistory.omeka.net/exhibits/show/at-home-in-skokie/at-home-in-skokie>, accessed March 8, 2025.

<sup>826</sup> In 2021, multiple flooding events in Skokie prompted officials in the Village to employ an environmental engineering consultancy and open a "flood damage questionnaire" to residents and property owners. Along with the questionnaire, Skokie published an overview of how the area's stormwater and sewage systems have developed (<https://www.skokie.org/277/Flood-Relief>, accessed March 8, 2025) over time in a context of landscape change. The overview is remarkable in capturing the complex interaction of suburban development, including proliferation of impermeable surfaces, and hydrology and expectations for comfortable life in single-family homes.

hold in water that did enter. Committed to the basement cultures that cement largely afforded, Americans developed supplemental technologies of flood control as well as social programs of remuneration and businesses of remediation that could protect and restore basement life in the event of disastrous infiltration.

Just as flood consciousness was peaking, a Pennsylvania utility broke ground on a project that would eventually reveal another liability to cemented basements. In 1969, the Philadelphia Electric Company announced plans to build a nuclear power plant that would supply electricity in Southeast Pennsylvania. The proposed plant on the Schuylkill River in Pottstown garnered resistance from area environmental groups. Global trials of nuclear generators in the 1950s and early 1960s had included a handful of frightening incidents. Most involved a combination of financial loss and radiation exposure with effects difficult to measure, but a 1961 steam explosion and meltdown in Idaho had killed three workers.<sup>827</sup> These risks, no doubt, made environmentalists fear construction in populous Pennsylvania.

Opponents did not suspect the new plant would reveal a pre-existing radioactive hazard, which basements were prone to exacerbate. Plant construction commenced in 1974 and continued for more than a decade, meaning engineer Stanley Watras was on site leading final projects in late 1984. When the plant's safety system went online, construction workers were asked to walk through the detectors intended to catch future contamination on the bodies of plant operators. With no nuclear fuel around, Watras set off the alarms. The detectors measured a level of alpha-particle radioactivity rivaling what would be expected in a uranium mine. The ensuing investigation ended conclusively with a measurement of particle activity in Watras' home, a short drive north from Pottstown into Berks County. The house's interior was clearly the source of exposure to Watras and also, presumably, his wife and two young children.

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<sup>827</sup> Drawn from various works by Benjamin Sovacool, scholar of energy industry disasters. Several incidents are covered in Spencer Wheatley, Benjamin Sovacool, and Didier Sornette, "Of Disasters and Dragon Kings: A Statistical Analysis of Nuclear Power Incidents and Accidents," *Risk Analysis* 37, no. 1 (January 2017): 99-115.

A host of suddenly interested parties—a group that quickly included neighbors, regional news outlets, and both state and federal entities including Congress and the EPA—wanted a fuller explanation. In the months that followed, a combination of geological surveying, subatomic theory, and health expertise offered details. The Reading Prong, a body of igneous rock that extends from the New Jersey border to the eponymous Pennsylvania city, underlay the Watras home. The rock contains uranium, and the soil layers above contain the associated series of decaying products, including the mobile gas radon and the alpha particles it constantly unleashes. The Watras incident, as it is commonly called, did for indoor air pollution what Alaskan tsunamis and Hurricane Betsy did for flood insurance, catalyzing congressional and EPA actions that broadly and definitively addressed indoor air quality.<sup>828</sup> However, plenty of the interested parties' attention went specifically toward the radon issue.

As public agencies raced to address radon fears by testing radioactivity in American homes, establishing an acceptable level of radon occurrence, and fostering a new workforce of remediation specialists, they also articulated that basements were a unique problem.<sup>829</sup> Radon's mobility in air usually leads to quick diffusion, but the foundations and insulation of modern homes altered this process disadvantageously for residents. The seven-foot walls and extensive floors of full basements created more contact surface between a home and the radon-laden soil, and basement space invited the gas in by way of air pressure differential. The Watras home was typical of the Mid-Atlantic, where among the over 10 million housing units that spanned the District of Columbia to the state of New York those with basements in the building outnumbered those without ten to one. In the City of Reading, county seat of Berks, 32,000 of the 33,000-some housing units were in buildings with basements.<sup>830</sup> Basement walls had

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<sup>828</sup> See Mitman, *Breathing Space*, especially page 192 in “On the Home Front,” for the national context of increased popular attention toward indoor pollutants during the early 1980s, attention that EPA actions failed to fully reflect until the agency's reaction to the Watras incident.

<sup>829</sup> U.S. Environmental Protection Agency, *Radon Reduction Methods: A Homeowner's Guide* (Washington, DC: U.S. Government Printing Office, 1986), 5-6.

<sup>830</sup> “Census Tracts: Reading, PA. Standard Metropolitan Statistical Area,” in U.S. Department of Commerce, Bureau of the Census, *1970 Census of Population and Housing* (Washington, DC: U.S. Government Printing Office, 1972), H-7; “Part I: United States Summary,” in US Department of

long been engineered to be less and less pervious or more and more impervious[?]to anything including airborne atoms. The walls and floors of modern basements, spaces increasingly heated for comfortable underground living, were poured thickly enough and often supplementally insulated to impede loss of climate-controlled air. Popular and governmental reactions to energy crises of the 1970s had extended effective insulation practices into the upper levels of many American homes. As a result, the typical single-family home in Southeast Pennsylvania was a trap for radioactivity. Particles of odorless, colorless radon could flow into basements through pores less than a nanometer in width but, barring very intentional ventilation of the basement space, were unlikely to flow back out.

Within three years, radon had been diagnosed well beyond the Reading Prong and was a major agenda item of the US EPA.<sup>831</sup> In 1987, the agency's survey of ten states indicated that one in five homes had radon accumulation above the hastily agreed upon action limit of four picocuries per liter. Further testing led the EPA to issue a "national public health advisory" in September of 1988 that included a call for standard radon tests in most homes. The radon issue generated both genuine alarm and countercharges of irresponsible alarmism. Some health experts estimated that radon inside homes was causing tens of thousands of lung cancer cases in the U.S. each year. Many medical professionals called those numbers exaggerated and pointed out that the true figure simply could not be determined without a longitudinal study that would likely breach ethical standards.<sup>832</sup> Regardless, into the 1990s the EPA prioritized radon

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Commerce, Bureau of the Census, *1960 Census of Housing, Vol. 1 – States and Small Areas* (Washington, DC: US Government Printing Office, 1963), 1-165 and 1-192.

<sup>831</sup> Kathryn Harrison and George Hoberg, "Setting the Environmental Agenda in Canada and the United States: The Cases of Dioxin and Radon," *Canadian Journal of Political Science* 24, no. 1 (1991): 3–27; "Radon Threat May Extend beyond Reading Prong," *The Morning Call* (Allentown, PA), October 2, 2021.

<sup>832</sup> Erik Eckholm, "Radon: Threat Is Real, but Scientists Argue Over Its Severity," *The New York Times*, Sept. 2, 1986. In 1987, two EPA scientists attempted to standardize the knowledge base from which fellow chemists and physicists engaged the topic of radon by publishing an edited volume: C. Richard Cothorn and James E. Smith, Jr., eds., *Environmental Radon* (New York: Plenum Press, 1987).

action by convening conferences on the subject, supporting state agencies and private businesses, and directly encouraging American homeowners to manage airflow at the bases of their homes.<sup>833</sup>

Despite the clear extra risk that basement living posed in radon-rich locations, basements largely avoided what could have been a public relations nightmare: a flip from imagined havens from nuclear threats to sites of reckless self-exposure. Early on, the EPA made blunt statements such as “Closing off and not using a basement may be advisable.” Basement disuse was a simple, expenditure-free alternative to structural mitigation projects.<sup>834</sup> Other suggestions focused on further sealing the basement space, often by adding sealant substances at joints or where pipes entered through walls but sometimes by simply covering exposed earth or cracked concrete floors with more poured concrete.<sup>835</sup> Increasingly, however, suggestions focused on added apparatuses such as fans and flues as well as structural redesigns meant to ventilate basements and make them safe, a goal quite different from abandoning the space. In the 1990s, the EPA explicitly de-emphasized basements as a radon threat, apparently out of concern that the public had completely, and unduly, dismissed any potential risk in homes without basements.<sup>836</sup>

Meanwhile, the real estate industry and private contractors took the basement issue into their own hands, developing practices that reassured homebuyers and offering ventilation retrofits that returned the feel of safety to American basements. In 1991, Stanley Watras became one of those contractors, establishing his own business that offered radon testing and remediation in Berks County. Neither he nor any of his family members developed negative health effects associated with radon exposure, but for

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<sup>833</sup> Much of home testing in the late 1980s and Congressional interest in testing schools and work places is documented in “Proceedings: The 1990 International Symposium on Radon and Radon Reduction Technology Held in Atlanta, Georgia on February 19-23, 1990: Volume I. Symposium Oral Papers (Sessions 1-4),” prepared for U.S. EPA Office of Research and Development and U.S. EPA Office of Air and Radiation by Radian Corporation, Research Triangle Park, NC, July 1991; U.S. Environmental Protection Agency and U.S. Department of Health and Human Services, *A Citizen’s Guides to Radon*, 2<sup>nd</sup> ed. (Washington, DC: U.S. Government Printing Office, 1992).

<sup>834</sup> U.S. Environmental Protection Agency, *Radon Reduction Methods*, 7.

<sup>835</sup> *Radon Reduction Methods*, 12-15.

<sup>836</sup> *A Citizen’s Guides to Radon*, 2<sup>nd</sup> ed., 4, 13.

decades he made his living from the possibility that others might not be so lucky.<sup>837</sup> Watras' radon mitigation business was joined by others across the country who found economic opportunity in bolstering or rectifying basement space. For example, in 1996 the City of Salina, its population shy of 45,000 and its surroundings consisting of rural Kansas, hosted at least ten contractors who advertised basement work. Eight specifically offered repairs and upgrades to address leaking water. One, Kansas Basement Repair, also promised to “reduce radon gas” by tactically injecting sealants rather than disruptively excavating.<sup>838</sup>

### Conclusion

The national housing census only tracked the existence of a basement under each housing unit on its 1960 and 1970 questionnaires. For the 1980 version, which followed Strategic Arms Limitation Talks between the United States and the USSR, the basement question was removed. It seems federal interest in basements was strictly a matter of nuclear preparedness concerns. Cold War policy had reflected the phenomenon of modern basements, and it elevated those architects, builders, and homeowners who had invested in private underground living. But national civil defense plans had interacted with a residential trend that was beyond federal power. American investments in basement living predated the atomic age, and in the ensuing decades the finished basement ideal had proven robust enough to withstand a set of conspicuous challenges, from the National Flood Insurance Act's specific refusal to underwrite basement living spaces to the 1980s revelations about radon. Both flood-soaked basement carpets and radon-laced basement air had spawned private businesses that offered remediation services.

On the one hand, basement remediation businesses were simply the newest participants in a long project of developing and maintaining home basement environments in the United States. Since the

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<sup>837</sup> Reviews of “S J Watras Inc., Radon Detection & Reduction, 32 Indian Ln, Boyertown, PA 19512,” Angi, viewed at <https://www.angi.com/companylist/us/pa/boyertown/s-j-watras-inc-reviews-156536.htm>, accessed March 8, 2025.

<sup>838</sup> “Classifieds: Your Guide to Special Services,” *The Salina (KS) Journal*, April 11, 1996, 14.

1930s, home builders and contractors, resourceful mothers, do-it-yourself fathers, and a host of other actors had been investing in cemented underground space and an array of cultural practices therein. On the other, proliferation of basement remediation contractors in the century's final decades signaled something new. The commercial opportunity those businesses captured sprang from a deep commitment to basement life. Their existence testified to the widespread value of basement cultures among American homeowners, especially in the northern half of the country.

By the century's final decades, many Americans expected their home basements to be free of unwanted natural elements because they wanted to feel comfortable spending time underground. They also wanted to feel confident that the various investments they made in those spaces were secure. Those investments could pay off in quality of life thanks to seasonal or eventual access to stored items, but they could also pay off in the form of higher home resale value. Many homeowners were parents who expected that sending kids downstairs to play was a healthy option for all, not a sacrifice of the children's long-term physical wellbeing in exchange for short-term mental relief. Socially, these Americans wanted to know their basements were an acceptable, even flattering place to host overnight visitors or party guests. Personally, they wanted basements to keep offering them relaxing retreats and reliable nooks in which to carry out the everyday activities from which they formed their identities. This range of desires and expectations, together constituting a cultural *mélange* centered on the safe basement, resulted from decades of interplay between the impermeable effects of cement and the ways that Americans chose to test, orient, realize, and supplement cement's control of underground space.

## CONCLUSION: FUTURE CEMENT SOCIETIES

In the summer of 2021, my wife, our one-year-old daughter, and I made a trip between major Covid waves and got to reconnect with family and friends. In a rare, luxurious moment of socializing after the toddler fell asleep, two of those friends asked about my dissertation project. I began trying to articulate what it was about, which at the time was just beginning to fully crystalize. I did not expect either of them to immediately understand what I meant by studying cement as a material that intimately shaped modern cultures. But one of them did.

My friend related that in his hometown, in central India, one indication of relative prosperity was to have concrete walls around your home. In the densely populated town (a veritable city most anywhere else in the world), concrete walls that thoroughly impeded vision and sounds afforded a measure of privacy that was sorely missed in their absence. This was immediately familiar to me for all the reasons it is likely now familiar to you, as someone who has read this dissertation. Cement is a barrier material, relished for its ability to separate matter and energy, even in many applications of concrete where its load bearing and its effective permanence are perhaps the more obvious characteristics. Cement is a material that allows for thorough cleaning with brooms and rags and water hoses. And cement is a highly standardized material, a result of scientific and industrial labors by scores of people over many decades. In fact, many South Asian industrial chemists, in the middle of the twentieth century, assumed the mantle of overseeing the science of what cement is and what it could be.<sup>839</sup> As in the United States, standardization and other research was supported by an industry organization, the Concrete Association of India, established in the 1920s. Indian cement science subsequently benefitted from government support

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<sup>839</sup> Vangipuram S. Ramachandran and R.N. Swamy, for instance, both trained in India during the 1950s, are two of the most prolific scholars of cement and concrete science in the second half of the twentieth century.

in the form of the Cement Research Institute (now called the National Council for Cement and Building Materials) and the Concrete and Soil Research Laboratory, both established after independence.<sup>840</sup>

The concept of a concrete wall as domestic luxury was new to me. It was also a welcome insight, because it confirmed a central premise of this dissertation. I have argued that cement, despite its homogeneity and relative inactivity once poured and set, has been a participant in the development of cultures that were in varying degrees specific to the United States and even to regions or communities within the country. It would follow, then, that India hosts an entire realm of cement cultures that are at once particular to the place and recognizable to outsiders thanks to the material's international continuities. I have since come to learn much more about India's recent cement cultures. For the past generation, television commercials from Indian cement brands including Ambuja, Nagarjuna, and Hathi, have aired in prominent slots during popular programming like high-profile cricket matches. Among the many commercials, two themes are common. One is bonds between family members, who might build something with cement together or, alternatively, might become separated by a concrete wall. In the latter case, the impediment of the concrete wall sometimes proves insurmountable despite people's desire to be together. This impenetrability is itself the second theme. Time and again, the strength of the advertised Indian cements defeats the people, the battering rams, the dynamite, the semi-truck, or even the ghosts who attempt to get through a concrete wall.

Few concrete structures need to be so cohesive as those in the Indian ads. Certainly, a wall around a home does not. Still, the ads point to a serious truth that complicates ongoing efforts to transition away from histories of conventional cement and its carbon emissions. Cement is stubbornly enduring, physically in the concrete structures it binds but also, as I have argued here, socially through its role as a co-creator of everyday life. The material is so thoroughly a component of society that it has become much more than simply a tool to be used toward this or that end or dropped in favor of an altogether different

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<sup>840</sup> Meenakshi A, personal communication with the author, October 4, 2024.

tool. In fact, cement use has persisted through the abundant criticism of concrete use that predates recent consideration of cement's global environmental cost. Brutalist concrete-based architecture, for example, has now been consistently lambasted for at least as long as it was en vogue. The longstanding description of city centers as "concrete jungles" is a pejorative that, in addition to its racial undertones, connotes the truly overbearing and callous qualities of endless cemented surfaces. Then there are the additional environmental issues of impervious surfaces and heat islands already mentioned in this dissertation's introduction.

In this dissertation, I too have often piled on the criticism and viewed cement as an overwhelmingly negative participant in society. In prisons, it generated insidious new punishment tactics. In sidewalks, it influenced new definitions of class based on consumer fashion and played a part in narrowing the acceptable forms of both mobility and outdoor leisure. In basements, it first invited middle-class women into a strictly gendered new role of homemaking and then protected indulgent new private practices of recreation. But in truth, cement's presence in society has been more than these social and environmental harms, and it would be irresponsible to call for a stop to using conventional cement without any alternative. That fact should not contradict the many thoughtful and valid arguments for using less cement in our built environments, such as sociologist of urban design Rob Imrie's *Concrete Cities: Why We Need to Build Differently*.<sup>841</sup> What it does suggest, however, is that for all its problems, millions of people around the world remain committed to this powerful material. A commitment that is based not only on personal privacy and cleaner sneakers, but also on cement's ability to help address unequal access to housing, basic sanitation, energy, and mobility at both local and national scales.

The Fifth National Climate Assessment, published in 2023 and one of the most painstakingly compiled and explained documents imaginable, has many indirect references to cement structures. One, for example: "Warming-induced increases in precipitation extremes lead to higher flash flood risks, with

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<sup>841</sup> Rob Imrie, *Concrete Cities: Why We Need to Build Differently* (Bristol University Press, 2021).

especially devastating effects in urban regions where impervious surfaces cannot absorb rainwater.”<sup>842</sup>

Recent severe precipitation events that have killed people and incurred tremendous public cost in US metro areas, Houston most famously, have made urgent the longstanding concerns about pavement’s overuse in developed areas. At the same time, the latest climate action guide for urban planners from the international C40 Cities Climate Leadership Group emphasizes increased density of the built environment and shortening of transportation distances to encourage lower-emission transportation.<sup>843</sup> That form of urban planning would seem to rely on sidewalks and invite the sort of mid-rise and high-rise construction that typically involves massive amounts of concrete. Concentrated people might even expect dense concrete walls for the benefits of quiet and privacy that my friend witnessed growing up in India.

While US emissions from cement production fell by more than ten percent between 2005 and 2020, from over forty-five million metric tons of CO<sub>2</sub> to around forty, the industry’s global emissions doubled in the same period. Vietnam’s cement emissions surpassed the United States, previously third in that category. From 2020 to 2023, the leading cement producer and user, China, averaged twenty times the US cement emissions and runner-up India’s production averaged four times the US emissions.<sup>844</sup> These behemoth figures that estimate mass of an invisible gas are impossible to truly comprehend, but we know them to be troubling in their climate consequences. That might easily lead to the familiar and hypocritical position of condemning the developing world’s use of a material that has been critical to modernization in wealthier nations.

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<sup>842</sup> P.E. Thornton, B.C. Reed, G.Z. Xian, L. Chini, A.E. East, J.L. Field, C.M. Hoover, B. Poulter, S.C. Reed, G. Wang, and Z. Zhu, “Key Message 2,” in “Chapter 6: Land Cover and Land-Use Change,” A.R. Crimmins, C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, eds., *Fifth National Climate Assessment* (U.S. Global Change Research Program: 2023).

<sup>843</sup> C40 Cities Climate Leadership Group, “Climate Action Guide for Urban Planners,” *Implementation Guides* (November 2024).

<sup>844</sup> Ian Tiseo, “Carbon Dioxide Emissions from the Manufacture of Cement Worldwide from 1990 to 2023, by Select Country,” [statista.com/statistics/1091672/carbon-dioxide-emissions-global-cement-manufacturing/](https://www.statista.com/statistics/1091672/carbon-dioxide-emissions-global-cement-manufacturing/), accessed February 26, 2025.

The cement industry is happy to remind the public, especially policymakers, about the material's role in shaping modern society. Circa 2020, a website called *Shaped by Concrete* appeared on the internet with a basic message about the material's ubiquity, its importance to infrastructures and modern built environments, and the role it might play in the twenty-first century's sustainability movement. Over the subsequent years, the Portland Cement Association (PCA) transformed the site into a cornerstone of the American industry's public relations. In addition to pointing out the historical role of cement, the site claims the material is an "important part of shaping our future as well."<sup>845</sup> PCA uses the *Shaped by Concrete* campaign as part of its wider project to rebrand cement as indispensable to projects of mitigating climate change consequences, eliding the industry's role in making climate a greater threat to people's quality of life. *Shaped by Concrete* is also a platform on which PCA touts various efforts to green the industry by major producers including behemoths LaFarge, GCC (formerly Grupo Cementos de Chihuahua), Cemex, and Heidelberg.

These greening efforts have had a real effect. In the policy environment of the early 2020s, cement firms operating in the US transitioned some smaller, more flexible plants toward production of portland limestone cement (PLC). Producing this material, which typically yields a modest (~10%) reduction in CO<sub>2</sub> emissions and was first endorsed by cement scientists more than twenty-five years ago, entails simply blending some raw ground limestone in with kilned cement product.<sup>846</sup> The industry is most inclined to shift smaller, often older factories into alternative processes like PLC. The cement plant at Trident, Montana, 112 years old when retrofitted for PLC in 2022, is one example of a small plant being designated for green public relations while the bulk of a firm's production, from massive new plants that

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<sup>845</sup> Portland Cement Association, "Concrete Shaping Our World," *Shaped by Concrete*, <http://www.shapedbyconcrete.com/#about>, accessed February 26, 2025.

<sup>846</sup> Jean Péra, Sophie Husson, and Bernard Guilhot, "Influence of Finely Ground Limestone on Cement Hydration," 99-105, in R.N. Swamy and Antoine E. Naaman, eds., "Portland Limestone Cements," a special issue of *Cement and Concrete Composites* 21, no. 2 (April 1999): 89-161.

would be costly to renovate, remains conventional.<sup>847</sup> Moreover, producers operating out of Europe and North America have diminished ability to remake an industry dominated by Chinese producers whose operations are now spread throughout Southeast Asia and into southern Africa.<sup>848</sup> China's cement firms are conspicuously absent from the Global Cement and Concrete Association, a group that represents eighty percent of cement volume by the rest of the global industry and has published a plan to achieve net zero emissions by 2050.<sup>849</sup>

Nonetheless, *Shaped by Concrete* gets at two important truths. The first, as this dissertation has argued, is that modern society *has* been shaped by concrete and its key ingredient, cement. The site is adorned with imagery of skyscrapers and of dams with tumbling water in otherwise undeveloped and verdant landscapes. While such megaproject structures have certainly shaped modern society, we know, too, that cement has shaped lives in more subtle yet no less important ways. The cement that held together prison cells created such dense barriers between convicts that reformers believed criminality itself was being quarantined. The most indisputable result, however, was psychological damage via understimulating isolation, which only became more severe and more intentional in the concrete age. The cement in sidewalks created enduring barriers between feet and earth that allowed city officials and property owners to lay artificial flagstones along many miles of city streets and public parks. Subsequently, Americans began wearing new styles of footwear as everyday shoes while also raising their

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<sup>847</sup> “GCC to Convert Trident Plant to Portland Limestone Cement in 2022,” *Global Cement News*, October 6, 2021; Portland Cement Association, “Sustainability Spotlight: GCC of America, Inc.,” *Roadmap to Carbon Neutrality*, <https://cementprogress.com/sustainability/harnessing-solar-energy-to-fuel-lower-carbon-cement-production/>, accessed February 26, 2025.

<sup>848</sup> See “China Seals Cement Deal with South Africa,” *The Financial Times*, May 13, 2010; Narayan Sharma, “Hongshi-Shivam Cement Factory Starts Trial Production,” *The Kathmandu (Nepal) Post*, May 20, 2018; “Cement Factory Strengthens Economic Development in Vientiane Province,” *Vientiane [Laos] Times*, August 18, 2018; Ferry Sandi, “Heboh Izin Pabrik Semen Baru di Ibu Kota Baru, Ini Faktanya!” [trans., “The Commotion Over the New Cement Factory Permit in the New Capital City, Here Are the Facts!”], *CNBC Indonesia*, September 10, 2021; Sena Voncuji, “Chinese Cement Manufacturers Pour into Africa,” *African Business*, December 12, 2024.

<sup>849</sup> Lara Williams, “World’s Second-Most Used Material, Concrete, Needs a Makeover,” for Bloomberg Opinion, as published in *The Taipei (Taiwan) Times*, October 26, 2024, 9.

expectations for how sidewalk space should be policed. The cement in basements invited the new middle-class homemaker to spend more time in a domestic subterranean that, prior to increased cement application, people of means and respectability had avoided for reasons of health and comfort. The ensuing cultures of home basement life that took hold in several US regions depended entirely upon cement's ability to keep underground spaces dry and clean. In each of these ways, Americans were shaped by concrete not only a grand scale of infrastructure networks but on the scale of proximate and tangible daily experiences.

The second truth on the *Shaped by Concrete* site is that, somehow or another, cement technologies will transform over the coming years. That transformation has already begun, not only in the scores of research laboratories developing alternative cements but also in the form start-ups like Material Evolution. This Middlesborough, England, company seeking to disrupt conventional cement production with an equivalent material that involves far less emission thanks to novel ways of incorporating blast furnace slag, a long-time cement additive.<sup>850</sup> Yet to be seen is whether this transformation is more like the gradual refinement that happened across the twentieth century or whether it evokes a wholesale redefinition of the nineteenth century developments. The public should expect the cement industry's transformation to be rapid and foundational. The industry's experiments in reducing emissions should be scaled up. There should be an increase in the qualities and diversity of cement materials available for construction projects big and small. The question then becomes what exact properties the new cements and concrete mixes will have, who will decide, and how those new materials will then shape everyday lives and the broader direction of societies.

In the past two years, I have been fortunate to work with a multidisciplinary team that is conceptualizing a remarkably different type of concrete. The team includes biochemical engineers and materials scientists led by Robin Gerlach along with environmental engineer Adrienne Phillips, civil

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<sup>850</sup> William Booth and Emily Wright, "Reinventing the World's Favorite Building Material," *The Washington Post*, October 31, 2024.

engineer Michael Barry, and philosopher of science Kristen Intemann. The project, funded by the US National Science Foundation's Emerging Frontiers in Research and Innovation, has a complicated name: Biofilm-functionalized and -maintained, living infrastructure systems (BLiSs). But it amounts to an attempt at working with algae, fungi, and even bacteria to co-create better concretes. An apt term might be "probiotics for infrastructure," since this good biota would provide services such as maintaining the concrete with cementitious discharge they produce or filtering heavy metals and microplastics out of water. Indeed, the team is testing highly porous concrete mixes that would allow water to run right through the structure and over the microbe-covered surfaces within, while maintaining as much as possible the concrete's ability to bear weight without cracking or crumbling.

Historical perspectives have helped the BLiSs team not only become more conscious of the departures they are making from sterile, impervious concrete as the public knows, but also to think from the start about how this new building material could affect society. The role of history in the project expanded over time. Initially, I applied historical cases to answer other researchers' questions about what barriers to widespread adoption of novel building materials they might anticipate. Drawing on other historians' studies of how people have understood environmental health or how they have categorized "natural" vs. "unnatural" systems provided insights about possible consumer hesitations about a microbial concrete. From a review of labor histories, I shared insights for how the existing construction workforce might react to a novel building material with different techniques and different values of what constitutes a satisfactory product. I have injected history into the team's conversations about the many opportunities for living concrete to take unintended paths of adoption if it were to become, for instance, a luxury good of purifying some neighborhoods, or stigmatized by its association with polluted places, or rejected because the biota produced an unwanted smell or appearance.

Bringing history into the BLiSs project has also highlighted the potential social benefits from a lower-cement, self-maintaining concrete that provides cost-effective ecosystem services. Indeed, these social benefits are what make the project worth pursuing. I have seen the team's visions of social benefits

influenced by awareness of concrete as a presence in everyday life at the personal, domestic, and communal scales that I have described in this dissertation. When the engineers and scientists periodically come together and zoom out from their individual expertise in 3D printing or rare strains of fungi or the practices of staining bacteria to make them photographable in the lab, they are increasingly thinking about how this prospective concrete will influence cultural phenomena. Just recently, a few of them used generative artificial intelligence (AI) in what I dare say is one of its more responsible applications, to create images of what life with living concretes might look like. While some of the results were grand futuristic cityscapes that looked like the Jetsons had gone green, with a presumably living concrete simply replacing conventional material in soaring skyscrapers and highways, others showed a neighborhood of closely set homes with shared yards and aquaculture systems. Team members overwhelmingly preferred this second category of visions, no doubt because it represented the society that an intentionally porous and ecologically positive concrete might shape. The Jetson bubble cars zooming from a discrete downtown to the separated suburbs and back, futuristic as they appear, are very much of the world in which we already live. It is a world in which over-reliance on material divisions as a source of comfort encourages notions that an illusory permanent security might be obtained through further separation in various forms. There is therefore so much hope in the BLiSs team's visions for a new concrete that could shape society by making infrastructure that preserves individual, corporeal health while it generates community health. And if anyone wants to literally build a better future, putting knowledge resources into a better concrete to build it with would be a great start.

The BLiSs living concrete project is just one in a multitude of efforts to more radically remake cement and reform its uses. It is not even unique at Montana State, where materials scientist Chelsea Heveran leads a separate team developing biologically assembled concrete in communication with similar projects emanating from a lab at the University of Colorado.<sup>851</sup> In addition to biofilm discharge from

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<sup>851</sup> Amos Zeeberg, "Bricks Alive! Scientists Create Living Concrete," *The New York Times*, January 15, 2020.

bacteria, experimental materials recently incorporated into concrete include hemp, blast furnace slag, coal ash, and carrots.<sup>852</sup> The primary goal in most research is to diminish the climate impact of concrete construction by reducing the amount of cement that is needed to achieve qualities of strength and cohesiveness on which people rely.<sup>853</sup> Yet the reality is that any successful changes to the industry will not be a simple substitution for conventional cement and concrete, and will, accordingly, have consequences well beyond carbon footprint.

The histories of conventional cement’s proliferation over the past two centuries, such as those recounted in this dissertation, reveal important implications for all these impending changes and therefore should be a conscious part of any effort to rethink building materials. Thinking about cement in the literal and figurative structures of American society, with specific examples of how the material has changed experiences and expectations, presents a better framework for decision makers in the laboratory or in the legislature. This history can and should inform cultural and political criteria by which public and private consumers might decide which aspects of cement are worth preserving and which should change in the decades to come. Understanding cement as a participant in history has helped the BLiSs engineers toward

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<sup>852</sup> Tarun Jami, Deepak Rawtani, and Yadendra K. Agrawal, "Hemp Concrete: Carbon-Negative Construction," *Emerging Materials Research* 5, no. 2 (2016): 240-47; Colter Roskos, Michael Berry, and Jerry Stephens, "Evaluation of Fly Ash Based Concretes Containing Post-Consumer Glass Aggregates." *ACI Symposium Publication 314* (March 2017); Ali Abdulhussein Shubbar, Hassnen Jafer, Anmar Dulaimi, Khalid Hashim, William Atherton, and Monower Sadique, "The Development of a Low Carbon Binder Produced from the Ternary Blending of Cement, Ground Granulated Blast Furnace Slag and High Calcium Fly Ash: An Experimental and Statistical Approach," *Construction and Building Materials* 187, no. 1 (2018): 1051-1060; Zbigniew Giergiczny, "Fly Ash and Slag," *Cement and Concrete Research* 124, no. 1 (2019); Yin Chi, Bo Huang, Mohamed Saafi, Jianqiao Ye, and Colin Lambert, "Carrot-based Covalently Bonded Saccharides as a New 2D Material for Healing Defective Calcium-Silicate-Hydrate in Cement: Integrating Atomistic Computational Simulation with Experimental Studies," *Composites Part B: Engineering* 199, no. 1 (2020); Chelsea M. Heveran, Sarah L. Williams, Jishen Qiu, Juliana Artier, Mija H. Hubler, Sherri M. Cook, Jeffrey C. Cameron, and Wil V. Srubar, "Biomineralization and Successive Regeneration of Engineered Living Building Materials," *Matter* 2, no. 2 (2020): 481-494; Seth Kane, Abby Thane, Michael Espinal, Kendra Lunday, Hakan Armağan, Adrienne Phillips, Chelsea Heveran, and Cecily Ryan, "Biomineralization of Plastic Waste to Improve the Strength of Plastic-Reinforced Cement Mortar," *Materials* 14, no. 8 (2021).

<sup>853</sup> Skibsted and Snellings, "Reactivity of Supplementary Cementitious Materials (SCMs) in Cement Blends."

their stated goal of designing concrete that will “better meet community needs and expectations, particularly for its most vulnerable and marginalized members.” The time to shape the future of cement societies is now, and the way to do it is in recognition of how cement has shaped society in the past and continues to do so today.

Like my friend growing up in central India, I hope that you, too, see cement as active in everyday life, shaping forms of privacy, strata of classes, desires for the future, and more. I hope you see that we can no longer take concrete for granted, either in the sense that its bearing on what transpires in society is limited and preconceived by humans or in the sense that building with concrete will remain the narrowly standardized activity it largely is today. As stated above, cement and concrete are in a transition period, and histories of living with cement can help guide that transition. But it is also true that vast amounts of cement and concrete will remain in the form they are today. John Smeaton’s lighthouse on the Eddystone Rocks, erected in 1759, was replaced in 1877 not because the masonry structure itself was failing but because the particular reef rock on which it was built was eroding at an unsafe rate.<sup>854</sup> Standard, fully industrialized cements are at least so enduring. With all of this robust material around us, we would do well to continue learning how cement impedes and channels matter and energy and thereby contributes to the ways we live our lives.

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<sup>854</sup> James Nicholas Douglass, “Note on the Eddystone Lighthouse,” in *Minutes of Proceedings of the Institution of Civil Engineers*, Vol. 53 (London: Institution of Civil Engineers, 1878), 247–248.

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