Industrializing a Landscape: Northern Colorado and the Making of Agriculture in the Twentieth Century

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INDUSTRIALIZING A LANDSCAPE: NORTHERN COLORADO AND THE MAKING OF AGRICULTURE IN THE TWENTIETH CENTURY

by

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B.A., San Jose State University, 1994

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A thesis submitted to the

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This dissertation entitled:
Industrializing a Landscape: Northern Colorado and the Making of Agriculture in the Twentieth Century
written by Michael A. Weeks
has been approved for the Department of History

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Weeks, Michael A. (Ph.D., History)

Industrializing a Landscape: Northern Colorado and the Making of Agriculture in the Twentieth Century

Dissertation directed by Associate Professor Paul Sutter

I examine the industrialization of agriculture in the irrigated region of Northern Colorado from 1870-1960. Initially, I analyze settlement and land use patterns in the last third of the nineteenth century, showing how settlers developed a sustainable form of mixed farming that incorporated animal husbandry, careful crop rotation, sophisticated irrigation and an orientation toward market farming. Next, I demonstrate how the beet sugar industry came to dominate agriculture in the region during the first half of the twentieth century, as farmers incorporated the new cash crop into their farming, while utilizing the byproducts of the beet sugar industry to feed their livestock. Becoming growers for Great Western Sugar initially held in place and augmented a mode of farming that was generally sustainable for the land and lucrative for farmers, while also transferring control over land use from farmers to a corporation.

My work also shows how the beet sugar industry created a permanent underclass of laborers. Cheap foreign sugar and delayed mechanization alongside corporate and grower demands for comfortable profits motivated the importation of German-Russian, Hispano, and Mexican labor. I show how Great Western and its growers kept contracted laborers on society’s margins and how this impacted housing, social relationships, education, and welfare. While laborers during the 1920s and 1930s chose to work in the beet fields, they resisted their
conditions through strikes, unions, and forming a proletarian culture. Their plight and activism attracted the attention of reformists who used labor conditions in the beet sugar industry to argue for agricultural labor reforms.

My research explains the drive for higher crop yields in American agriculture during the twentieth century. I show that, while mechanization offers some answers, the adoption of chemicals and synthetic fertilizers were essential in expanding yields and displacing farm laborers. In addition, I argue that USDA scientists and agricultural colleges provided much of the labor and research necessary to expand productivity, suggesting that understanding the evolution of modern food systems requires close historical scrutiny of the relationship between industry and state-sponsored science.
ACKNOWLEDGEMENTS

There is no way to show the full measure of gratitude that should be accorded all of those people who have made this possible. Nor is it possible to even mention everyone who has helped me along the way. But I know that all learning, no matter how lofty or mundane, is not an individual exercise. Whatever I have gained from the last six years, I owe to a valued community whose support goes far deeper than the pages that follow.

I have been fortunate to have access to numerous local research collections and excellent archivists who have staffed them. David Hays at Norlin Library helped me navigate the immense Great Western Archives at the University of Colorado and tipped me off to a manuscripts collection of sugar beet laborers that I would not have found otherwise. He was always good for some lighthearted banter and much needed perspective. Clarissa Trapp was my most common point of contact at Morgan Library at Colorado State University. She introduced me to unprocessed collections and always seemed happy when I showed up to research. Linda Meyer helped me to navigate the Colorado Experiment Station and Extension Records. Patricia Rettig provided more aid and insight than I can quantify, identifying several water collections, providing free passes to an annual gathering of Colorado water professionals, and clueing me into a funding opportunity that will keep some of my research afloat post-dissertation.

Amongst my fellow graduate students, at CU, I wish to thank Jennifer Cullison, Chris Baker, Doug Sheflin, Pete Veru, and Alessandra Link. A special thanks goes out to Sara Porterfield and Karen Lloyd. Sara always made me laugh and kept me sane since, for her, there is never a clear line between adventure, academia, and a good pint of local beer. All are necessary. Karen Lloyd has encouraged me, read much of my work, been available when I
needed help, and even provided research opportunities through her museum connections. She is a model colleague and an awesome human being.

Reading and commenting on over 300 pages of text is no small task, and I am thankful for Phoebe Young, Jill Lindsay Harrison, and Mark Fiege for reading what I wrote carefully and commenting insightfully. Thomas Andrews read the whole draft twice and gave copious feedback. No scholar I know brings as much passion to the mundane process of revision.

Finally, Paul Sutter is a model advisor. Not only has he spent countless hours analyzing my shaky prose and leaky arguments, but he constantly forces me to separate the wheat from the chaff in my work. Paul has enabled me to identify who I am as a scholar.

Friendships and academia constantly blur. No one embodies that more than Bill Unrau, my octogenarian friend and professor emeritus at Wichita State. I met him the day after I arrived in Boulder. He and his wife Millie have been the source of food, laughter, academic gossip and support.

In 2004, while teaching high school, my wife, Sacha, noted my passion for history and suggested I consider graduate school. Neither of us had any idea where it would lead – and still don’t. There was more grace in that offer than she knows. Whatever is worthy in what follows, I owe to Sacha.
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Introduction

Few cities in the American West today more readily identify with industrial agriculture than Greeley. In 1970, it was the epicenter of the largest set of commercial feedlots in the nation. Greeley’s economy revolved around Monfort Feedlots, a company which fattened, slaughtered, packed, and shipped an average of 300,000 cattle each year. The company contracted with farmers all over the Piedmont to provide the feeds necessary to fatten its cattle. Corn was the most important feed, made possible by hybridization, irrigation water, and the extensive use of chemical fertilizers and biocides. The company also contracted with the chemical giant, Dow, to manufacture the plastics necessary to pack and ship its beef to points as far away as Japan. Few residents could disregard Monfort since it was as recognizable by its smell as by its beef. Hundreds of thousands of cattle packed into feedlots produced copious wastes whose odors invaded olfactory senses as far away as Cheyenne to the north and the suburbs of Denver to the south. With deep connections to Colorado State University (formerly Colorado Agricultural College), Monfort Feedlots contracted with the university to develop smell deterrents to minimize its odiferous stigma. For some, the odor of feedlot cattle was simply referred to as the smell of Greeley. For others, it was the smell of money. Without a doubt, Greeley smelled like industrial agriculture.\(^1\)

Though Monfort Feedlots is now owned by JBL Five Rivers, one of the four largest meatpacking firms in the world, most of Greeley’s feedlots remain, and I wanted to get an up close view (and smell). So I decided to pay a visit. As I approached one set of feedlots south of Greeley, the first thing I noticed was a putrid odor that grew in strength as I drew closer. This was not the smell of manure in pastures, but of concentrated excrement. Shortly, the scene

which produced the odor materialized. In countless pens, each about the size of a residential plot, a cohort of seemingly identical black cows crowded in front of rows of feed troughs where they chewed, snorted, and coughed their way through a meal. The ground on which they stood was uniformly brown and lifeless, offering a stark contrast to the vast fields and pastures which, until a few moments ago, had dominated my senses. In the center of the pens sat two landmarks. One was a water trough whose liquid was pumped in from local irrigation canals. The other focal point was an amorphous mound of manure that grew and receded as pens were cleaned. In one particularly dystopic scene, a cow stood atop one of these fecal hills as if to proclaim temporary lordship over her pen-mates. As I traveled past these feedlots, my eyes gazed skyward where a tall, white building loomed. At first glance, it appeared to be an industrial sized grain silo. On further investigation, I discovered that this was only partially true. Various elevators brought grains, roughage, vitamins, minerals, and antibiotics into the structure where the work of engineers, nutritionists, and computer experts enabled this feed mill to produce the daily rations of feedlot cattle. Machines, computers, pharmaceuticals, industrial feeds, and scientific expertise made for an efficient industrial operation.

At first glance, this scene bore no resemblance to the Union Colony that settled this very spot in 1870. The Union Colony came as a cooperative venture with barely enough capital to build one its four planned irrigation ditches. Though some of the colonists possessed livestock, colony records indicate that they were few in number and largely grazed on the open prairie that surrounded the colony. Moreover, concerns over cattle often had more to do with how to fence them out of their farms than confine them within. Settlers struggled to engineer irrigation canals, fought with neighboring towns, and eked out a living on relatively small acreage. A year after the Union Colony settled, they named their town Greeley, after the *New York Tribune* editor and
failed 1872 presidential candidate who contributed money, encouragement, and editorial space to the colony. That seems to be all that this early settlement shared with the modern town of Greeley.²

The startling contrasts between the Greeley of 1870 and the Greeley of 1970 begged for an explanation. As a historian, I am a teller of stories and in the transition from the small-scale, cooperative farming of the Union Colony to the modern-day industrial agriculture of Greeley, I knew I had a good one. I started by asking what made Greeley a particularly industrial place. In my mind I immediately sketched a narrative arc that presented as a fall from grace. The villains of the story were big agricultural corporations that employed capital and resources to exploit a population of small farmers incapable of resisting. They harnessed the region’s land, labor, and water to their purposes, destroying ecological niches that had evolved over millennia. It was a clear story of declension whereby unrestrained abuse of people and the environment by a small cohort of capitalists resulted in a denuded landscape and a disempowered population.

I admit that this is the story I wanted to find. During my career as a graduate student, I employed much of my free time trying to grow my own food. I frequent farmers’ markets, and pay close attention to where my food comes from and the methods of its cultivation. The works of Michael Pollan, Barbara Kingsolver, and Wendell Berry occupy prime spots on my bookshelf.³ Words like ‘synthetic,’ ‘processed,’ ‘artificial,’ and ‘high-fructose’ are anathema to me. So, when I encountered Greeley’s modern-day feedlots, I was immediately repelled, but not so much by the smell. The feedlots seemed to violate the intimacy I desire with the food I eat

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and the land on which it was produced, replacing them with remote industrial processes designed to subdue nature rather than cooperate with it. I confess to being a romantic when it comes to agriculture. Being deeply suspicious of industrial agriculture, it was easy to envision a research project that would map onto my own sensibilities.

Historical reality soon trumped romantic visions. Since I knew that industrial agriculture generally involved the consolidation of land and resources into fewer hands, I looked for ways in which power centralized. What I found instead was that Greeley, and most of the surrounding region was characterized by small-scale farmers in the late nineteenth century and, despite an orientation toward cash crops and some land speculation, land and wealth remained widely distributed. Further, the one industry in the region where money seemed to concentrate during that period – cattle ranching – came crashing down in the 1880s when ranchers overstocked the range and failed to care for the land on which their livelihoods depended. In their case, nature not only presented limits but turned dreams of capital accumulation on their heads. The town of Greeley in particular, and Northeastern Colorado in general did not yet fit into the historical box I had created for it.

Even when capital investments in the region multiplied and wealth seemed to accumulate, as they did in the early twentieth century, nature still presented limits. When the beet sugar industry – the source of much of that capital - attempted to bend the region’s landscape to its will, company scientists at Great Western Sugar and researchers at the U.S. Department of Agriculture (USDA) and land grant colleges quickly learned that beets could not be grown on the same land year-in and year-out. Further, the initial failure of the corporation and its growers to maintain farmland resulted in the depletion of soil nutrients and in poor harvests. Moreover, Great Western learned that replacing those nutrients depended on working
with its growers to develop a combination of effective crop rotations and mixed husbandry to maintain profitable crop output. In addition, the company was constantly concerned about water. It needed enough water to process beets into sugar, but its growers depended on that same water to grow beets in the first place. Industry growth required squeezing every last drop out of a resource that was in limited supply. The story of the region’s agriculture was turning out to be a story in which dependency and limits characterized industry.

What I began to see was that heavy capital investment could not so easily bend agriculture to its will. This was especially true when it came to labor. When I first viewed the feedlots in Greeley, I was awed by how mechanized the feeding operations were, and how few people there were amidst thousands of cattle. I anticipated a corollary in the sugar beet fields. What I uncovered only partially fit. While I expected to see an exploited labor force providing much of the energy necessary for cultivating beets, I assumed that they would recede by the 1920s and 1930s as farm technology and the internal combustion engine replaced their labors. My predictions as to the condition of laborers proved somewhat accurate, but my technological forecasts failed. Despite the best efforts of industry leaders and scientists, they failed to engineer beets that could be mechanically cultivated and harvested until the 1950s, long after most of the major crops on the Great Plains and the American West had yielded to technology. While I found evidence of exploitation, I also observed that industry could not so easily oblige organisms to synchronize with modern machinery.

But where were the cattle and the feedlots? Whenever they appeared, they were always in the background during the first half of the twentieth century – consuming sugar beet byproducts, providing fertilizer in the form of manure, and offering meager income for farmers who fattened modest numbers of livestock during the winter. How then did this cattle-fattening
side business come to epitomize industrial agriculture in northeastern Colorado? It turned out that answers were found as much in the lab as in the field. Developments in plant breeding, chemistry, pharmaceuticals, and veterinary medicine made it possible to fatten cattle year-round on inexpensive feeds in tight spaces. This is where I came to one of my most important realizations. The story of industrialized agriculture in northeastern Colorado was as much about developments outside the region as those within it. Farmers, laborers, and corporate agriculture were bound up together with laboratories and manufacturers of agricultural implements and chemicals. Relationships were not linear, but networked, and the story about a particular place was also about many places.

If research and relationships outside of Northeastern Colorado were essential for explaining industrial agriculture, then I had to understand what energized them. I discovered many of my answers in the archives and publications of state-sponsored scientists who operated within the complex of agricultural colleges and the USDA. State-sponsored researchers developed much of the science and technology that made industrial agriculture in Northeastern Colorado possible. Researchers experimented with different crop rotations, developed feed regimens for livestock, built and tested farm machinery, engineered irrigation canals, formed professional organizations, and conducted field trials with seeds and agricultural chemicals. Their work directly benefitted companies such as Monfort and Great Western by enabling them to overcome environmental obstacles and develop economies of scale. Products developed through their relationships with manufacturers of agricultural implements and chemicals allowed farmers to reduce their dependence on traditional practices such as manuring and crop rotation. I learned that histories of industrial agriculture could not be told apart from state-sponsored science since the two were deeply entwined through the first two-thirds of the twentieth century.
The more I delved into my research, the more I became aware that disentangling that web was essential for telling this story.

Simply put, industrial agriculture involves orienting the labor and capital of crop and animal production entirely around market demands. On the farm, this requires that farm managers maximize yields and minimize costs. The energy necessary to grow crops and animals may come from farmers, animals, contracted laborers, machines, chemicals, petroleum, biological inputs - antibiotics and hormones for example – or any combination thereof. Since energy inputs have evolved as a result of science and technology, so has the combination of inputs used on the farm. Further, since minimizing costs is a defining feature of industrial agriculture, producers seek to pass off the costs associated with production and waste to the environment, consumers and to the state. As farmers orient their lands around industrial production, they generally specialize in one or a few crops that can maximize profit. Consequently, their role as consumers is transformed. Instead of consuming food and fiber grown on their own lands and maintaining farm productivity with crop rotations and locally available fertilizer, they consume fuels, chemicals, fertilizers, and foods manufactured elsewhere. None of this is possible without heavy capital inputs. To maximize production and minimize associated costs requires economies of scale capable of processing crops and animals, exploiting raw materials, and distributing agricultural products to consumers. While capital and profit motivate modern agricultural production systems, they require the sort of scientific and technical expertise adept at engineering transportation systems and the kind of ongoing research capable of manipulating crops, animals, and soils to overcome environmental limits. Since much
of the expertise inherent within industrial agriculture has been either supplied or subsidized by the modern state, any historical definition of the term must bring the state in.\(^4\)

While defining the central subject of my research informs my interpretation, industrial agriculture did not arise fully formed on the Northern Colorado Piedmont. Consequently, industrial agriculture only becomes legible through the story of its evolution. For example, though one of the central goals of industrial agriculture was to turn the farm into a site of rationalized production, tuned to market demands and modeled after a factory, environmental, social, and technological factors consistently presented limits. Insects, variations within weather and snowpack, labor relations, and the halting progress of agricultural science all defied efforts to rationalize agricultural production. Modern static definitions are exercises in teleology. Because the majority of modern day agricultural is based on an industrial model, we tend to forget that agriculture still revolves around fitting the complex web of interactions occurring in soil, air, and water to food production. To effectively study what is industrial within modern agriculture is to study the process that made the end product. We must observe its development play out over time, in a particular place, and with an evolving network of actors – human and non-human. This is the story of the process that made industrial agriculture on the Northern Colorado Piedmont.

This study is bounded spatially by what historical geographer William Wyckoff calls the Northern Colorado Piedmont. The physical geography of this region includes the South Platte River, its Front Range tributaries, and the lands adjacent to these waters. The South Platte River emerges from the Rocky Mountains southwest of Denver, winds its way through the city, and

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\(^4\) “Bring the state in” is a reference to the work of Theda Skocpol, who argued in 1985, that historians needed to scrutinize state bureaucracies more carefully as active agents in shaping society. See Theda Skocpol, “Bringing the State Back in,” in Peter B. Evans et al., eds., \textit{Bringing the State Back in} (New York: Cambridge University Press, 1985), 3-43.
then arcs in a northeasterly direction through the state until it merges with the North Platte River in Nebraska. As it courses away from Denver, the South Platte collects the waters of several other streams including Boulder Creek, the St. Vrain River, the Big Thompson River, and the Cache La Poudre River. The Northern Colorado Piedmont is distinguished from the Plains by its proximity to streams and the availability of irrigation from those streams. The region is also distinguished by easy access to transportation. By 1880, all of the towns on the Piedmont possessed easy access to rails that could take their goods locally to Denver and each of the most populated Colorado towns that lined the eastern front of the Rocky Mountains. They were also linked by rail to the Union Pacific Railroad which could take their goods anywhere in the United States. By 1900, few agricultural regions in the American West were as well-suited to industrial agriculture as the Northern Colorado Piedmont.5

The Piedmont is an important, yet under-studied center of agricultural production from the late nineteenth through the mid twentieth century. Most states in the West apportion their water according the Doctrine of Prior Appropriation, a series of statutes and legal precedents that allot water to individual users based on the date of settlement and the amount of water they are able to put to ‘beneficial use.’6 Many of the precedents for those laws originated when Piedmont settlers initially attempted to divert water from streams and came into conflict with others seeking to do the same. Yet, while much has been written about Prior Appropriation, little has been said about the agricultural development of the region that pioneered Western water law.


The reality on the ground was that the Piedmont remained among the most important centers of irrigation into the twentieth century. Until the 1920s, Colorado vied with California for the most irrigated acreage in the nation, and the Piedmont possessed far and away the most irrigated acres within Colorado. The Piedmont’s land grant college, Colorado Agricultural College (Colorado State University today) possessed one of the nation’s first agricultural engineering programs. It employed early water pioneers such as Elwood Mead, who played an outsized role within the Bureau of Reclamation, and Ralph Parshall, whose device for measuring irrigation water still predominates in ditches throughout the West.

The historical study of agricultural development in the West is dominated by studies of California, and this yields a fragmented and sometimes misleading picture. I hope to re-orient studies of western agriculture toward other locales. Unlike most of the arid West, California water law was a hybrid of prior appropriation and riparian rights, and many of its large water projects, such as the Central Valley Project were undertaken by Reclamation. Piedmont water development, like water developments in much of the West, was far more local and decentralized, and Reclamation played only a minor role. In addition, while California’s Central and Imperial Valleys quickly industrialized, their histories are not analogous to much of the West where colder climates, smaller populations, and moderate capital investment suggest a much more prolonged development of industrial agriculture. Starting in 1900, when California was the

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tenth leading producer of agricultural products in the United States, its ranking has steadily risen until 1960, when it sat atop the rankings – a position it has held ever since. No other Western state has even cracked the top ten. While this certainly offers an argument for California’s importance, it suggests that California’s agricultural development is not representative of the rest of the American West. In that sense, examining agriculture on the Piedmont - where environmental factors, crop selection, and land use patterns slowed industrialization - may provide a better template for understanding western agriculture.

A review of agriculture in the American West during the late nineteenth and early twentieth centuries demonstrates the resonance of Piedmont agriculture in the region. Though California was at the vanguard of wheat farming in the West, by the end of the nineteenth century, the state had almost entirely transitioned away from the crop since it could not elicit the high returns possible in the fruit and nut orchards of the Central Valley. By contrast, Piedmont farmers continued to grow wheat well into the twentieth century, since it remained an economical crop and could perform well within a limited set of crop rotations. In fact, during World War I, when worldwide demand for wheat skyrocketed, some of the largest increases in wheat production occurred on the northeastern Piedmont, where the South Platte River flowed out of Colorado and into Nebraska, a region also dominated by wheat. What was true on the Piedmont was true elsewhere in the West. Regions such as the Palouse Hills of Eastern Washington, the Arkansas Valley of Colorado, and much of the Dakotas and Montana persisted in growing wheat from the late-nineteenth through the twentieth centuries. As a cash crop adapted to the soils and climate of those regions, it was one of the most reliable crops for farmers to plant. A similar story could be told for alfalfa. Although, it was widely planted in California

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in the nineteenth century to support livestock feeding, it had fallen out of favor by the twentieth century, along with the livestock it helped to feed. Throughout most of the irrigated West a different story prevailed. On the Piedmont, in the Snake River Valley, and wherever colder climates and irrigation were the norm, alfalfa supported the nutritional needs of beef and dairy cows, as well as sheep. It was also used as a soil conditioner since it fixed nitrogen into the soil to support productive crop rotations.10

Sugar beets illustrate another way in which Piedmont agriculture offers a useful template for Western agriculture. Though the Piedmont was the nation’s leading producer of beets after 1910, it was a staple crop in states such as Utah, Nebraska, Montana, Idaho, and California. However, in California, sugar beet growers were primarily large, wealthy farmers. This was because they had purchased most of that state’s best agricultural land prior to 1860. By the end of the Civil War, when settlers with lesser financial means began to move westward in large numbers, the costs of arable land in California were prohibitive, and so they looked elsewhere. According to the terms of the Homestead Act, they could gain title to 160 acres of land for a nominal fee of $10 after living on it and improving it for five years, or they could simply make small improvements and buy the land for $1.25 per acre after six months. Alternately, settlers could purchase better lands from the railroads or land speculators, as many on the Piedmont did.

Though costs could still bar entry for some, they could not compare with costs in California, which were running as high as $10 per acre in 1860. Consequently, while California was quickly dominated by large, heavily capitalized, corporate farms, much of what remained for settlement in the West in the post-Civil War era were small farms. So, while a beet sugar company in California might contract with a few growers to plant thousands of acres for one of its factories, sugar refineries throughout most of the West commonly made agreements with hundreds of growers to gain the same quantity. Though it is true that land speculation was rampant in the American West and the overarching trend was toward consolidation of land into fewer hands, we gain a misleading picture of the historical processes that transformed land ownership if we use California as our template. Like the Piedmont, much of the West was dominated by small to mid-sized farmers in the late nineteenth and early twentieth centuries. Corporate agriculture and largescale co-ops emerged over time in response to increasing land values, and advances in farm technology, and were spurred on by the research and promotions of agro-industry, the USDA, and land grant colleges.

The Piedmont offers a more representative historical picture of pesticide usage in the West than California. By the early twentieth century, the Central Valley was dominated by high-dollar orchard crops. Historians Steven Stoll and Richard Sawyer have shown that the wealthy farmers who operated within the groves and orchards of California quickly adopted lead and arsenic based pesticides to protect their fruits from insects and to preserve an appealing

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12 On the early development of industrial agriculture in California, see note 8. For a specific example of large farmers contracting to grow sugar beets in California, see Torsten A. Magnuson, “History of the Beet Sugar Industry in California,” *Annual Publication of the Historical Society of Southern California* 11, no. 1 (1918): 68–79.
appearance for its consumers. Growers also put pressure on state-sponsored scientists to conduct research to foster the ongoing use of these synthetics. With the exception of the apple-growing Yakima Valley in Washington and the emerging cotton industry in the Southwest, pesticide usage in the West prior to World War II was limited. Most biocides in existence until that time could kill or damage the varied crops of the region, or could not simply be washed off in the same way that lead arsenate could be rinsed from an apple. Consequently, if farmers used them at all, it was in response to specific outbreak of insects or plant disease. It was not until after World War II, when a host of organic pesticides entered the market that could kill weeds and insects selectively without causing short-term harm to food crops, that farmers throughout the West made chemical agriculture central to land and crop management. The Piedmont typified this pattern. As products of agro-industry, chemicals were essential to the industrialization of agriculture. While extensive capital and specific crop selection enabled California growers to embrace chemical technology in the late nineteenth and early twentieth century, the available science and crop selection for farmers on the Piedmont and in most of the West, delayed the wholesale adoption of chemicals. This provides additional evidence for the slow industrialization of the Western agriculture, a pace modeled on the Piedmont.

This study correlates agricultural practices with environmental change over time in a particular region within the American West. While this may seem elemental, it brings together periods that historians often separate. It is common to end studies of western agriculture during

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the 1920s and 1930s, or to focus primarily on the period following World War II. This yields a fragmented picture since many of the technological and scientific innovations that transformed agricultural practice and the relationship between farmers and the land occurred during the interwar period and were then put into practice following World War II. Thus, it is easy to view the earlier period as characterized by limits on environmental impacts, while the latter era becomes a narrative of environmental degradation. While I do not entirely question those conclusions, by examining changes on the ground in a chronological sweep that encompasses both periods, I aim to provide a more satisfactory picture of environmental and agricultural transformations. In particular, I show how evolving relationships and research agendas within the agro-industrial complex between 1900 and 1960 mapped onto agricultural practice. I argue that understanding agro-environmental change over time requires close scrutiny of the scientific networks that helped to produce it.

My work informs discussions on the history of water and the American West. Irrigation was the lifeblood of Piedmont agriculture and at the heart of every pivotal period in the region’s agriculture. The first successful agricultural settlements were driven by the need to divert water onto arid farmlands. Access to water drove the introduction of most of the new crops in the region, and every significant increase in crop yields could be tied to increased water use. Poor mountain snowpack and constricted water flows could decimate the crops of farmers with junior water rights while enabling those with more secure rights to make a tidy profit by selling excess

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16 Studies that conclude during the 1920s and 1930s include Fiege, Irrigated Eden; Stoll, The Fruits of Natural Advantage.
17 Andrew Duffin’s work on the Palouse region of Washington State provides an exception. However, the defining environmental feature within his narrative is erosion, which played a more limited role on the Piedmont. See Duffin, Plowed under.
irrigation water. While Piedmont farmers possessed varying degrees of water security, they were universally bound by a form of agriculture that demanded access to water for success.

While historians such as Donald Worster have forcefully argued that intense irrigation, of the variety that was embraced by Piedmont farmers, resulted in concentration of power and wealth, such was generally not the case on the Piedmont. Rather, farmer pooled their resources to build irrigation canals, ditches, and reservoirs and then incorporated their water rights into mutual irrigation companies. Far from centralizing power, these companies were small and jealously guarded the water rights of their users. Through the late nineteenth and most of the twentieth century they were loath to sell their water rights. As a consequence, water rights in the region were tightly controlled and widely dispersed. Widely dispersed water also distributed wealth widely, while it also contributed to inequality. In the West, there is a strong correlation between water’s abundance and its ability to produce wealth. On the Piedmont, those with senior irrigation rights generally benefitted from escalating land values. However, since most landholders possessed modest acreage, and water was so broadly distributed, few farmers became truly wealthy. However, by the 1930s, little or no new water was available. This essentially blocked new farmers from acquiring land and water on the Piedmont while enabling existing farmers to take advantage of escalating land and water values. While control over water promoted wealth accumulation, the broad distribution of water dispersed that wealth, and Piedmont water politics precluded centralized control.18

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18 Worster and Pisani have written extensively about the relationship between water, wealth and power. According to Worster, irrigation in the West has resulted in the consolidation of power into the hands of those with the capital and expertise to manipulate it. On the other hand, Pisani argues that western water development was not guided by coherent federal planning, but instead was decentralized and guided by local conditions and circumstances. While there is some evidence of water as a vehicle for consolidating wealth and power on the Piedmont, the region’s development fits Pisani’s model far more than that of Worster. See Worster, *Rivers of Empire*; Donald J. Pisani, *To Reclaim a Divided West: Water, Law, and Public policy, 1848-1902*, 1st ed (Albuquerque: University of New Mexico Press, 1992).
Legal control over a given quantity of water rarely translated to physical control over that same quantity. To illustrate this, I examine the largely overlooked role of irrigation engineers who were responsible for designing irrigations works and determining effective and egalitarian means of distribution. While some historians have located water expertise in federal agencies such as a the Bureau of Reclamation, I argue that the sort of expertise that had the greatest impact on water engineering and distribution on the Piedmont was in the hands of scientists working at Colorado Agricultural College and cooperating agencies. They developed devices for shoring up leaky reservoirs, measuring water in irrigation canals, and even evaluating annual mountain snowpack in order to predict water’s availability. My work suggests that any understanding of water’s historical relationship with western growth in the nineteenth and twentieth centuries should pay close attention to local water politics and to the scientists who engineered irrigation works.19

While irrigation water was the most essential natural resource for industrial agriculture on the Piedmont, the beet sugar industry was the most significant source of capital accumulation between 1901 and 1950. Growing demand for sugar, a protective tariff, and a critical mass of farmers willing to grow beets enticed entrepreneurs to quickly build six beet sugar factories between 1901 and 1905. No sooner had the factories been completed than they attracted the attention of the American Sugar Refining Company, also known as the sugar trust. Headed by Henry Havemeyer, the sugar trust quickly purchased a controlling interest in each operation and consolidated them under the name Great Western Sugar. Over the next decade, Great Western Sugar built four additional factories, and became the largest manufacturer of beet sugar in the

19 For examples of books that address the role of the Bureau of Reclamation in Western water development see Pisani, Water and American Government: The Reclamation Bureau, National Water Policy, and the West, 1902-1935 (Berkeley: University of California Press, 2002); Worster, Rivers of Empire.
nation. It maintained a horizontal monopoly on beet sugar processing on the Piedmont, a region that was refining almost one-third of the nation’s domestic sugar by 1930.\textsuperscript{20}

Patterns of labor exploitation described by many historians parallel those employed by Great Western Sugar on the Piedmont.\textsuperscript{21} I show that the corporation’s constant desire to lower its labor costs not only determined how laborers were ordered and paid, but in how the company addressed housing, risk management, education and politics. Since laborers were drawn from migratory communities, the company needed to secure living arrangements to maintain a workforce. Consequently, the company shifted the burden of housing to growers, which not only limited up-front costs, but enabled the company to shift complaints about poor accommodations off to its growers. The company and its growers also developed contracts that made workers responsible for unforeseen events that slowed thinning, cultivation, and harvesting. Further, in choosing a migratory labor force, the company created crises within the public and private institutions that administered education and social welfare. Finally, for most of the period from 1900 to 1934, the company successfully convinced Congress that a high tariff on foreign sugar was absolutely essential for a viable beet sugar industry in the United States while also claiming

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that sugar beet agriculture offered humane working conditions and a living wage. While it was true that labor costs for processing beet sugar were higher than those in cane sugar producing regions such as Cuba, the company’s ability to exaggerate the differences yielded fantastic profits.

I aim to go beyond exposing how the business model of agricultural industrial giants such as Great Western ordered their relationships with labor to show how various local and national groups, and laborers themselves, understood that relationship. Efforts by reformers to end child labor and provide expanded educational opportunities spotlighted Great Western’s exploitation of its workers. Religious organizations, journalists, educational reformers, labor organizations, rural sociologists, beet laborers, women’s groups, and the National Child Labor Committee all weighed in. Their arguments revealed how perceptions of race colored broader subjects such as housing and the type of labor certain classes of migrants were fitted for. They revealed tensions regarding the fairness of measuring Great Western’s corporate profits against the wages that it paid to its workers, and what constituted living wages. During the Depression, efforts by reformers to improve the living conditions of laborers highlighted how corporate labor prerogatives and public assistance were deeply entangled. My work shows that, though agricultural giants such as Great Western sought to marginalize its labor force, work in the fields played a significant role in many of the larger political, social and reform movements during the first third of the twentieth century.

Historians of capitalism and industrial agriculture have questioned the degree to which nature has been simply a vehicle for capital accumulation and whether capitalism was historically compatible with ecological health. Evidence supplied by Piedmont agriculture in

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22 Worster has argued that capitalist regimes encourage the exploitation of nature so that individuals can accumulate wealth. He further argues that, prior to 1930, the very idea that the health of the land should constrain
the twentieth century suggests that answering that question is largely depended on the crops being grown, and how and where capital and labor were apportioned. The most significant capital outlay for the beet sugar industry was in its refineries. Owing to the bulkiness of beets and the need to process them rapidly after harvest before their sugar content decreased, Great Western Sugar had to place those factories within the immediate vicinity of sugar beet growers. The sugar company was not just investing in an industry, but in a place. Growers, who typically owned their land, generally chose to grow beets for Great Western Sugar since beets were the most lucrative crop available. They also fed their livestock with sugar beet byproducts, and fertilized their lands with the manure that resulted. In short, the corporation and its growers depended on one another – for beets, for feeds, and to maintain soil health. While all farming creates biological disruptions, capitalism and sustainable agriculture were relatively compatible on the Piedmont at least until 1930 primarily because the corporation and its growers depended on local resources, meticulous soil maintenance, and on each other for their success.

Those local interdependencies were ruptured in the post-World War II era primarily because science and technology enabled farmers, feedlot operators, and agro-industry to divorce their operations from local resources. Advances in plant breeding, an explosion of agricultural chemicals, and new technologies for managing and feeding cattle in tightly packed feedlots ruptured former dependencies and turned farmers and feedlot operators who formerly relied on human activity was abhorrent in the United States. In his analysis of commercial chicken feeding operations, William Boyd argues that nature was viewed by agro-industry as a series of constraints to be overcome through technological and scientific expertise. Others, such as Bart Elmore, in his analysis of Coca Cola’s business practices, have argued that successful capitalist regimes indirectly exploit nature by demanding cheap raw materials and thus forcing suppliers to cut corners on environmental responsibility. See Worster, Dust Bowl: The Southern Plains in the 1930s (Oxford: Oxford University Press, 1979); William Boyd, “Making Meat: Science, Technology, and American Poultry Production,” Paul Sutter and Christopher J. Manganiello, eds., Environmental History and the American South: A Reader (Athens: University of Georgia Press, 2009); Bartow J. Elmore, Citizen Coke: The Making of Coca-Cola Capitalism (New York: W.W. Norton & Company, 2015).
local biological and interpersonal webs into consumers of chemicals and fertilizers produced in distant factories. While crop yields increased, Piedmont farmers and feeders increasingly relied on a bevy of industrial products to solve problems that were once controlled through traditional farming methods such as meticulous crop rotations, and application of locally available manure, both of which encouraged soil regeneration and limited pest infestations. My work largely agrees with that of historian Colin Duncan who argues that, for capitalism to promote an ecologically healthy landscape, producers must be made to depend on locally available resources, “giving them a built-in incentive to watch over that part of the environment in which they are actively interfering.” Industrial agriculture requires heavy capital investments. Divorced from responsibility to local lands and local peoples, its relationship with the land and its natural resources is primarily one of exploitation.23

Scientists within various agencies of the U.S. Department of Agriculture (USDA), and within the complex of agricultural colleges played a significant and underappreciated role in the development of industrial agriculture. Where they shared common goals and agendas – and, broadly speaking, they usually did – I will use the term ‘agri-state’ to refer to this complex of scientists and officials. Agri-state employees encompassed the only publicly funded conglomeration of scientists and officials whose mission was to serve the needs of farmers specifically and American agriculture more generally. I argue that they largely failed in their

23 Colin Duncan is one among several historians, philosophers, and scientists who have argued for local responsibility in land use. Some, such as Barry Commoner did not believe that capitalism had to be hostile to nature. Others, such as Wendell Berry and Donald Worster have implied or directly stated that capitalism is always hostile to the environment. Wes Jackson, on the other hand, while largely skeptical of capitalism, believes that a scientific approach to local land use can sustain a productive and biologically healthy agriculture, even in the presence of capitalist modes of production. See Colin A. M. Duncan, The Centrality of Agriculture: Between Humankind and The Rest of Nature (Montreal: McGill-Queen’s University Press, 1996); Barry Commoner, The Closing Circle: Nature, Man, and Technology, 1st ed. (New York: Knopf, 1972); Berry, The Unsettling of America; Worster, Dust Bowl; Wes Jackson, Altars of Unhewn Stone: Science and the Earth (San Francisco: North Point Press, 1987).
mission. The trajectory of agri-state research on the Piedmont from 1900-1960 showed a decided inclination to favor the prerogatives of industry. As scientists from agro-industry promised greater efficiency and expanded yields through science and technology, agri-state officials failed to question potential harms. Rather, they claimed that the products of industry, when used as directed, were unqualified goods. This philosophy led agri-state researchers and scientists to conduct the majority of field trials necessary for industry to bring its products to market. In the process, agri-state researchers became junior partners with agro-industry and the site of agronomic research expertise moved from public science on the Piedmont to private industry in distant labs. Further, by placing so much faith in efficiency and expanded yields through technology, state-sponsored scientists supported a knowledge economy whereby performing experiments aimed at uncovering the long-term impacts of applying chemicals to the land or questioning the value of industrial products in agriculture had become largely taboo. I argue that, by offering unflinching support for industry, agri-state scientists and officials failed to safeguard the farmers and the lands that were essential to their original mission. This forestalled much of the criticism of industrial agriculture that finally emerged during the 1960s.24

24 Interpretations of the research role of land grant colleges and the USDA vary considerably. Charles Rosenberg argues that, by the early twentieth century, research scientists at land grant colleges and the USDA had been able to establish research prerogatives “based on shared interest in growth and productivity through the rational application of science.” He also argues that, though most researchers believed in the value of small, family farms, their work caused them to gravitate toward heavily capitalized farmers and toward industry. In her analysis of the development of hybrid corn, Deborah Fitzgerald argues that land grants, the USDA, and the seed industry largely worked together to develop hybrid corn. However, land grant colleges such as the University of Illinois discontinued their support for hybrid seed research once it became clear, in the 1940s, that hybrid corn was a commercial product. In the 1973 Hightower Report, researchers harshly criticized land grant colleges for abandoning farmers in favor of industry. By arguing that agri-state officials failed to question how industry products harmed the land and harmed farmers, I largely agree with the Hightower Report. See Charles E. Rosenberg, No Other Gods: On Science and American Social Thought, Revised and expanded ed (Baltimore: Johns Hopkins University Press, 1997), 153–199; Deborah Kay Fitzgerald, The Business of Breeding: Hybrid Corn in Illinois, 1890-1940 (Ithaca: Cornell University Press, 1990); Jim Hightower and Agribusiness Accountability Project, Hard Tomatoes, Hard Times: The Original Hightower Report, Unexpurgated, of the Agribusiness Accountability Project on the Failure of America’s Land Grant College Complex and Selected Additional Views of the Problems and Prospects of American Agriculture in the Late Seventies (Cambridge, Mass: Schenkman Pub. Co, 1978).
In my examination of the specific technologies of industrial agriculture, I focus especially on chemicals for several reasons. While mechanical technologies sped up farming and replaced human labor in the fields, machinery could not supplant biological relationships in the same way that agricultural chemicals did. The manufacturers of chemicals asserted that their products could completely replace the need to rotate crops or utilize on-the-farm manures and green crops to replenish soils and control insect infestations. They claimed to be able to kill all crop-threatening pests and supply chemically what had formerly been supplied by biological interactions between organisms and minerals in the soil. At best, chemicals were only able to solve pest problems and supply nutrients for one season, making frequent chemical consumption a pre-requisite for crop production. And there was no turning back since chemicals permanently disrupted ecological relationships on which sustainable farming was based. Agricultural lands became addicted to chemicals. Of all the technologies brought to bear on the Piedmont from 1900-1970, none played a more substantial role in eroding the interdependent relationships that had once tied the region’s agriculture to locally available resources.25

In chapter one, I trace the settlement and land use patterns on the Piedmont that would shape agricultural development in the twentieth century. Cattle ranchers and market-based crop farmers possessed divergent motives for settling in the region. Crop farmers employed intensive farming, irrigation, and, in some settlements, a limited commitment to communal farming. Cattle ranchers, on the other hand, utilized the relatively mild Northern Colorado weather and the short grass prairies of the extensive public domain to fatten cattle, investing minimally in land,


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farm buildings, and feeds. I show how, by 1900, the most successful farmers and ranchers on the Piedmont had embraced a mixed farming that integrated stock raising and the growing of crops.

Great Western Sugar’s entry into Piedmont agriculture mapped onto that development. In chapter two, I show how existing crop rotations and stock raising patterns fit seamlessly with the new sugar beet agriculture, creating a relationship of dependency between the new agricultural corporation and its growers from 1900-1930. Through an examination of crop rotations, sugar refinery operations, and financial relationships, I challenge the notion that capitalism and sustainable farming are, by definition, antithetical. But capitalism did exploit people, as I demonstrate in chapter three. The sugar company and its growers recruited migrant laborers and employed them in a system of contract labor whereby entire families toiled in the sugar beet fields. Using Great Western’s publications, the records of beet labor advocates, and evolving labor contracts from 1900-1940, I show how Great Western and its growers systematically marginalized its workforce and crafted a narrative that cast migrant laborers as both fairly treated and essential. By contrast, labor advocates worked to expose the poor schooling, harsh working conditions, and powerlessness of families in the beet fields. Their arguments are at the heart of debates during the period over concepts such as a living wage, public welfare, and the rights of laborers to organize on the one hand, and to what degree the state can regulate corporate profit on the other.

Water access drove industrial agriculture on the Piedmont. The ability to divert water from Piedmont streams animated settlement, the opening of new lands, sugar beet agriculture, livestock feeding, and every major change in the crop profile of Piedmont farmers. In chapter five, I argue that farmers’ need for water inspired settlers and university-trained scientists to engineer a labyrinthine system of irrigation canals and storage reservoirs, while their concurrent
need for wide distribution of water dulled efforts to centralize power. That need spotlighted the importance of irrigation engineers, such as Colorado Agricultural College engineer Ralph Parshall, who invented devices to prevent water from escaping the irrigation infrastructure and for measuring it more precisely to its users. This chapter provides a modest corrective to historical works that emphasize the importance of federal water projects in the twentieth century. On the Piedmont, where Anglo settlers pioneered western water law, power consolidated slowly and was vested primarily in small irrigation companies.

The state takes center stage in chapters four and six where I examine the relationship between researchers at the USDA, agricultural colleges and agro-industry. In the hopes of expanding sugar production prior to World War II, state-sponsored scientists increasingly cooperated with the seed and chemical industries, manufacturers of farm implements, and the largest and most heavily capitalized growers. The result was that agri-state research agendas came to mirror those of industry. Further, that growing pro-industry ethos led agri-state researchers to emphasize field trials for chemical companies over some of the basic research that might have resulted in questioning the human and environmental consequences of pesticides and synthetic fertilizers. I show how modern agriculture has substituted chemicals for soil biology as factors in food production, and that this transformation must be traced through the research relationship between agri-state scientists and agro-industry.

By 1970, the Piedmont possessed all the markings of industrial agriculture. Heavy capital investments ushered in corporate farming and concentrated livestock feeding operations while re-making individual farmers into smaller pieces within a larger division of agricultural

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labor. Efforts by farmers and industry to lower production costs had both pulled imported labor into the region and then expelled that labor through mechanization and chemicals. Irrigation development throughout the period showcased efforts by farmers, boosters, and state-sponsored scientists to wring every last bit of productivity out of an essential resource. The growing presence of state-sponsored researchers and their willingness to subsidize agro-industry encouraged farmers to divorce their labors from biological processes and replace them with industrial chemicals. Capital, industry, infrastructure, water engineering, chemicals, and the state made industrial agriculture on the Piedmont.
Chapter 1: Cattle, Crops, and Colonies

On December 23, 1869, Nathan Meeker stood before an expectant New York crowd. They were largely drawn to the gathering by an advertisement which Meeker had placed in the *New York Tribune* earlier in the month. The ad stated that all parties interested in forming a town and agricultural colony in the Colorado Territory should attend the December 23 meeting. Meeker was encouraged in his ambitions by his boss, Horace Greeley, editor of the *New York Tribune*. Greeley was best known for his participation in the abolitionist movement, friendship with Abraham Lincoln, and support for Radical Republican causes during the Reconstruction era. In 1872, he switched political parties and ran unsuccessfully for president against Ulysses Grant. As a supporter of communal agriculture and westward movement, Greeley suggested that Meeker “take hold of it” when Meeker explained his plan for an agricultural colony in Colorado.

Many of those present at that 1869 meeting shared Meeker’s fervor, and fifty-nine of them paid a five dollar initiation fee that night as evidence of their desire to join the Colorado-bound colony. More than eight-hundred individuals, whose combined financial assets totaled over one million dollars, also wrote letters indicating interest in what Meeker had named the Union Colony. Though the majority of them did not follow through on their interest, within four months, Greeley received over four-hundred applicants who pledged at least $160 to obtain a lot in the new Union Colony. In April, 1870, a location committee that included Meeker selected a site near the confluence of the Cache la Poudre and South Platte Rivers, and agreed to purchase an initial 9,000 acres on that site from the Denver Pacific Railroad. Initial settlers arrived in the summer of 1870. A year later, the Union Colony boasted over 1,000 residents.27

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Between 1870 and 1900, the development of crop farming in the Union Colony, and in the remainder of the irrigated Northern Colorado Piedmont, came to possess all of the markings of intensive cultivation. Intensive cultivation refers to the use of the land and all of its resources for the maximum production of high value crops. A portion of the money required to set up the Union Colony was set aside by its founders to build irrigation works. Early settlers believed that the land would yield abundant harvests if only sufficient water was available. Consequently, most colony settlers deliberately selected plots of land far less than the 160 acres common under the Homestead Act with the impression that irrigation water would yield abundant returns. As farms quickly radiated outward from watercourses, Piedmont residents developed complicated engineering schemes and legal frameworks to irrigate additional lands while storing limited water supplies during the drier months of the year. Intensive cultivation was also evidenced by rails. In addition to water access, Union colonists favored their settlement site over others due to its access to the Denver Pacific Railroad, believing that the growing city of Denver would form a healthy market for their crops. As the Piedmont grew, farmers and local boosters successfully lobbied for a spur rail line that would connect to the Union Pacific in Wyoming. Not coincidentally, that line largely paralleled the South Platte River. By 1900, rail lines criss-crossed the Piedmont. Emphasis on small acreage, irrigation, and access to transportation attracted large numbers of settlers. By 1900, the Northern Colorado Piedmont’s productive,

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29 As the Union Colony was the first settlement to engage in largescale irrigation on the Piedmont, their experience inspired some of the legal framework for water law in Colorado. See David Schorr, *The Colorado Doctrine: Water Rights, Corporations, and Distributive Justice on the American Frontier*, Yale Law Library Series in Legal History and Reference (New Haven: Yale University Press, 2012).
well-watered, and densely organized system of farming displayed all of the markings of intensive cultivation.\textsuperscript{30}

Perhaps the most surprising aspect of these first thirty years of agricultural development was that cattle ranchers became an integral piece of this intensively farmed landscape. When the Union Colony was founded in 1870, cattle ranchers had been operating in Northern Colorado for over a decade. Operating on large acreages within the public domain, they hoped to become wealthy not through developing the landscape, but through feeding cattle on the short-grass prairie already in existence. They theorized that cattle could be fattened for market simply by branding them, turning them lose onto the prairie and occasionally rounding them up or leading them to available water sources. Profit came not from intensive management but minimal supervision as cattle ranchers bought cattle and turned them lose to gain weight from eating the native prairie grasses. During the early 1880s, that philosophy attracted massive amounts of capital to the Piedmont as foreign firms attempted to strike it rich by grazing cattle. But that enterprise came to a crashing halt in the late 1880s as overgrazing, winter storms, and a falling market for beef brought cattle ranchers to their knees. Those that survived could no longer rely on prairie grasses since overgrazing had denuded the landscape. They had to manage the food and water sources for their livestock. The need for greater care required ranchers to keep their cattle behind fences for at least part of the year, find a way to provide hay and other feeds, and acquire irrigation water. In other words, Piedmont cattle ranchers began to look more like crop farmers.\textsuperscript{31}

\textsuperscript{31} James S. Brisbin and Newberry Library, \textit{The Beef Bonanza, Or, How to Get Rich on the Plains Being a Description of Cattle-Growing, Sheep-Farming, Horse-Raising, and Dairying in the West} (Philadelphia: J.B. Lippincott & Co, 1881); Maurice Frink, \textit{When Grass Was King} (Boulder: Colo.: University of Colorado Press, 1956); Richard Goff, \textit{Century in the Saddle} (Colorado Cattlemen’s Centennial Commission, 1967).
To a lesser extent, crop farmers began to look more like cattle ranchers by 1900. It turned out that irrigation water was not sufficient to make the land blossom with produce. Farming fence row to fence row depleted the soil of vital nutrients. The most important of those was nitrogen, an element essential for plant growth. And livestock manure provided one of most abundant and available sources of nitrogen in a form plants can utilize in their growth. During the era of the open range, cattle scattered their feces all over the Piedmont. However, when cattle were managed behind fences, that manure – and its nitrogen content – became available to crop farmers. Further, crop farmers employed green crops such as clover and alfalfa both to fix nitrogen into the soil and as a nutritious additive to hay for fattening cattle. The upshot of these developments is that crop farmers recognized their need for cattle ranchers and cattle ranching simply was not possible without incorporating more intensive livestock management and some degree of mixed farming.

Agricultural scientists also help us to understand the Piedmont’s intensively managed landscape. In 1887, the federally sponsored Hatch Act provided funds to develop experiment stations at agricultural colleges throughout the nation. Colorado’s first experiment station was in the Piedmont town of Fort Collins on the campus of Colorado Agricultural College (CAC). Beginning in 1889, the college performed experiments that mirrored the needs of Piedmont farmers. These included research on the nutrition needs of cattle – including the use of locally available alfalfa, - studies on insect pests that attacked crops and cattle, and engineering research on the efficiency of irrigation works. They published farmers’ bulletins, conducted demonstrations on college lands and those of farmers, and held classes for farmers and ranchers to help them apply the latest science to their livelihoods. While it is possible to overstate their pre-1900 influence, there is no question that experiment station scientists had become productive
and influential members of the Piedmont farming community and largely supported the intensively developed agriculture in the region.\textsuperscript{32}

During the 1870s, the movement to form agricultural colonies in Colorado brought new settlers to the Piedmont who would have a profound impact on the region’s agricultural development. These colonies were associations of individuals and families, usually from larger cities to the east, such as Chicago, St. Louis, and New York, who pooled their resources together to move west. Rather than homesteading or buying lands from the railroads separately, colony organizers solicited prospective settlers who desired to form a town. Settlers then paid initiation and membership fees, which would entitle them to acreage in the new colony. Organizers then purchased large tracts of land from the government and the railroads. Land was generally selected based on access to water and proximity to rail lines. Fees paid by colonists as well as credit made these purchases possible. However, would-be colonists understood that their funds would be used not only for land purchases, but also for the essentials of forming a town. This included streets, a town hall, a school, and various other requirements for making a community. Proceeds from the purchase of residential and business lots, as well as that of additional agricultural land within the colony, were similarly used for the development of the town. In this way, colonists gave up some of their individual autonomy in the hopes of succeeding where other settlers in the West had failed.\textsuperscript{33}

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\begin{itemize}
\item \textsuperscript{33} Wyckoff, \textit{Creating Colorado}, 101-153, and James F. Willard, \textit{The Union Colony at Greeley, Colorado, 1869-1871}, University of Colorado Historical Collections, v. 1 (Boulder, 1918). xiv-xvii.
\end{itemize}

It was not town infrastructure but water that most concerned Piedmont colonists. Most of the region received precipitation considerably below twenty inches annually, far less than was necessary for growing the colonists’ preferred cash crops such as wheat, alfalfa, and potatoes. Consequently, colonists prioritized the development of irrigation over all other concerns. On the Northern Colorado Piedmont, this meant diverting water from the South Platte River and its tributaries. Money acquired through initial membership fees and subsequent land sales were pooled to redirect water onto the arid lands of colonists.34

These colonies, which were the dominant form of planned settlement on the Piedmont from 1870-1875, provided an alternative to the common narrative of Western settlement.35 Colonists, though they may have been imbued with ideas of individual liberty, chose to forsake some of their autonomy in order to help their collective endeavor succeed. Further, they did not represent the underclass of the East and the Midwest who sought land in the West to alleviate their poverty. Since colonists were required to pay at least $160 – in the case of the Union Colony - to the colony before emigrating westward (many contributed more than this), it is clear that they were at least solvent, if not financially comfortable.36 Further, they owned their water – the lifeblood of agricultural success – communally.37 In short, the dominant form of initial

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34 Ibid.; See also Steven Stoll, _Larding the Lean Earth: Soil and Society in Nineteenth-Century America_ (New York: Hill and Wang, 2002), 204-208.
35 According to Willard, Colorado received over 5,000 new residents through colonies in 1870 and 1871, with the majority of those new additions settling on the Piedmont.
36 Early historians of the West, such as Frederick Jackson Turner and Walter Prescott Webb have argued that the West was a “safety valve” which released the social pressure from the eastern United States. The experience of colonies on the Piedmont does not fit that pattern, since those who formed colonies did not represent classes of society likely to foment unrest. See Frederick Jackson Turner, _The Frontier in American History_ (New York: H. Holt and Company, 1920), and Walter Prescott Webb, _The Great Plains_ (Lincoln, Neb.: University of Nebraska Press, 1981).
37 The experience of the colonies on the Piedmont runs contrary to the narrative thread put forth by Donald Worster who argues that agricultural settlement in the arid West eventually led to corporate and government dominance over water resources. While some small-scale irrigation companies formed on the Piedmont during the late nineteenth century, there was relatively little government involvement in the development of water resources until the 1930s. See Donald Worster, _Rivers of Empire: Water, Aridity, and the Growth of the American West_ (New York: Pantheon: 1986).
agricultural settlement on the Northern Colorado Piedmont was planned, co-operative, and conscious of how to make market agriculture pay in an arid and sparsely populated region.

The Union Colony was the first colony on the Northern Piedmont, and it provided the template for future cooperative agricultural endeavors. Its most notable founders were Horace Greeley and Nathan Meeker. Greeley was influenced by the French socialist Charles Fourier who, in the 1830s and 1840s, inspired several utopian farming communities in the United States. Fourier promoted cooperative agricultural communities in which each member would bear responsibility for the social welfare of others within the community. By focusing one’s efforts toward the success of the entire community, wealth would be distributed more equitably amongst its members. Though Greeley generally supported Fourier’s ideas, he stopped short of complete communalism, believing that farms should be organized around the family and that property should be privately held.38

Greeley, editor of the New York Tribune, felt that the American West was the ideal region to see his philosophy put into practice. Having toured the West in 1859, he recognized that the arid, sparsely populated region required irrigation for successful farming. In addition, he understood that the creation of irrigation works would necessitate capital beyond the financial reach of the typical homesteader, requiring western settlers to pool their resources to bring water to their crops. Thus, Greeley posited that the cooperation required to divert water naturally strengthened the sort of agricultural colonies he promoted. Further, Greeley argued that irrigation, when combined with intense cultivation of crops, would enable farmers to produce bountiful harvests on small plots. Thus, colonists could live in close proximity to one another,

succeed in market agriculture, and work together to build a community without the geographic separation created by farming on large acreages.\textsuperscript{39}

Although Greeley’s ideas about farming in the West were essential for establishing the Union Colony, he neither settled there nor contributed much in the way of physical or organizational labor. In that regard, Nathan Meeker played the largest part. As the agricultural editor for the \textit{New York Tribune}, Meeker was a friend and colleague of Horace Greeley. He had spent thirteen years in a Fourierist agricultural colony in Ohio and, after traveling to Colorado in 1869, was convinced that a similar colony could thrive there as well. Meeker then approached Greeley. The aging \textit{Tribune} editor responded enthusiastically: “I wish you would take hold of it, for I think it will be a great success, and if I could, I would go myself.” Eventually, this support took the form of monetary aid and generous editorial space in the \textit{Tribune}.\textsuperscript{40}

Following his meeting with Greeley, Meeker placed an ad in the \textit{Tribune} which described the location of the new colony, the philosophy it would embody, and the requirements for those who wished to join. Though the exact location had not yet been chosen, Meeker had been persuaded by Denver newspaperman and real estate booster William Byers to consider the South Platte drainage. Meeker eventually obliged in his selection, in part due to its proximity to the sole line of the Denver Pacific Railroad. The text of Meeker’s editorial emphasized the healthfulness of the land and its resources. He gushed that it was well-watered, with rich soil, pine groves, and access to stone and other building materials, as well as coal for heating. Meeker was also careful to emphasize colony access to roads and rail lines. Meeker’s stress on rail access was well-placed, but his description of pine groves, easy access to water – irrigation was

\textsuperscript{39} Ibid.
\textsuperscript{40} Willard, \textit{The Union Colony at Greeley}, xix-x xv; Wyckoff, Creating Colorado, 126-130; Boyd, A History, 29-38.
necessary for access, and building irrigation works was not easy – and abundant coal were exaggerated. Meeker further argued that the mild climate and healthful land of the colony could support both cash crops and the keeping of stock, while still offering access to plentiful wild game. Meeker punctuated his evocative description by emphasizing the unparalleled scenery of the region.

For the new Union Colony to be successful, Meeker highlighted several requirements. First, the land would be purchased as a block to avoid land speculation, and settlers would be required to pay membership and initiation fees up front. These funds would be used to establish a town and develop irrigation. Farming acreage would be located in close proximity to the town and kept small (initially he proposed 40-80 acres parcels) since he argued that irrigation would yield abundant produce and smaller plots would foster a more tight-knit community. Though the Union Colony would primarily be an agricultural community, Meeker emphasized the need for individuals in trades such as baking, blacksmithing, and milling to sign on in order to provide basic services and build up the town quickly. Finally, in a nod to the reform philosophy out of which many colonies originated, Meeker stated that temperance would be the rule of the colony.

Meeker wasted no time organizing the colony. On December 23, 1869, at an initial public meeting for interested parties, more than eight-hundred individuals, many of whom represented entire families, whose combined financial assets totaled over one million dollars, had written letters indicating a desire to join the Union Colony. At the same meeting, fifty-nine

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42 Nathan Meeker, “A Western Colony,” New York City Tribune, 4 December 1869.

people paid a five dollar initiation fee and many more pledged to do so. Prospective colonists then formed an executive committee was to oversee the new colony. The executive committee elected Meeker colony president at that meeting. In January 1870, a locating committee which included Meeker and other members of the executive committee, set out to select a site for the colony. In early April they chose a valley on the Cache la Poudre River, three miles above its confluence with the South Platte River. Within a week, the executive committee had agreed to purchase 12,000 acres of primarily Denver Pacific Railroad land. Though Meeker undoubtedly played the largest role in the founding of the colony, he refused the suggestion that it be named after him. The Executive Committee then put forth the name of the New York Tribune’s chief editor. Thereafter, the Union Colony would be called Greeley.44

By some measures, the town of Greeley experienced great initial success. Within one year of its founding, colonists built 232 houses for the more than 1,000 inhabitants who had relocated to the town, making it the fourth largest town in the Colorado Territory. Colonists completed nine miles of irrigation canal, and were in the process of building 30 additional miles to re-direct the waters of the Cache la Poudre River to thirsty farmers’ lands. Simultaneously, colonists finished churches and a school, and were hard at work building a town hall. They also undertook co-operative efforts to build both grist- and saw-mills.45 On initial glance, Greeley not only was thriving, but it owed much of its success to the philosophies of Horace Greeley and Nathan Meeker.

Though Meeker and Greeley argued that both their economic and cooperative visions were essential for the town’ success, Greeley’s early history demonstrates that cooperation was merely a social means to an economic end. This was evident from the start. Colonists moving to

45 “Greeley,” *The Denver Tribune*, 13 April 1871, p. 4; *The Chicago Tribune*, 19 November 1870, p. 4.
Greeley understood that the town’s success would depend first and foremost on its agricultural productivity. Since plots were small – the majority of agricultural plots were under 80 acres - farmers understood that financial success required intensive cultivation of high value cash crops. Further, they expected that abundant irrigation would propel high yields of potatoes, wheat, corn, beets, and fruit – all of which commanded high prices. In addition, they believed that easy rail access, a growing regional population – especially in Denver - and the area’s booming mining industry would offer a steady market of customers for their produce. Moreover, founding residents of Greeley joined the colony in the hopes of making quicker profits than were otherwise possible through homesteading, a process which would have entitled them to more acreage for less money, but promised neither water rights nor easy access to markets since few available homestead lands in Colorado possessed proximity to rivers or rails. The most valuable agricultural lands available for purchase were held by the railroads. Early tensions illustrated the primacy of Greeley’s economic philosophy over its social one.

Conflicts over irrigation revealed strains in colony ideals. Initially, colonists planned four irrigation ditches to provide Greeley with water. Ditch Number Three would provide water for the town and so colonists commenced building it immediately. The far more expansive Ditch Number Two would provide enough water to farm crops for each of the founding colonists. The executive committee for the Union Colony estimated that total costs for these two ditches would be $20,000. Unfortunately, Ditch Number Three alone required $25,000 to complete. This left no funds available to construct a waterway for farmers. Considering that Greeley was an agricultural colony, this presented problems. In order to finance Ditch Number Two, the Union Colony Executive Committee levied additional taxes on both new lots and the subdivision of property, and they diverted some of the original funds allocated for the development of the town
to irrigation. This was a source of tension between colonists whose livelihood was based in the town of Greeley and sought its development, and those whose source of income was farming and who required irrigation for success.\textsuperscript{46}

Financing irrigation projects was not the only obstacle to moving water from the stream to the farm. Knowledge of irrigation in the American West was in its infancy, and Greeleyites built ditches and canals that did not perform as they desired. Poorly cut ditches resulted in eroded banks and seepage, while canals without a consistent fall line caused water to either move too swiftly or pool up in one location. Water that seeped into ditch banks facilitated unwanted growth that sucked up water intended for crops. When that growth eventually died it was carried downstream, eventually created ditch-clogging debris. In their cost calculations, Union Colony founders assumed incorrectly that maintaining ditches would be inexpensive. Colonists not only lacked the funds for irrigation, but the know-how to carry it through.\textsuperscript{47}

These setbacks presented opportunities for Greeleyites to display their founding cooperative philosophy. Though residents certainly came together to build, repair, and fund irrigation projects, the conflicts created by water tore at the fabric of their ideals. In 1877, the town gladly sold its corporate ownership of Ditch Number Two to the farmers who used its waters, who then formed the Cache la Poudre Irrigation Company. Control over the direction of this new entity was in proportion to the size of the water rights of its users. In succeeding years, these farmers expanded the capacity of Ditch Number Two, eventually serving agricultural interests that were not tied to the original Union Colony. Ditches Number One and Four were eventually built, though not by the town on Greeley. Ditch Number One became the Larimer

\textsuperscript{46} According to Boyd, the total costs of building Ditches Number Two and Three was $412,000; See also Rose Laflin, \textit{Irrigation, Settlement, and Change on the Cache la Poudre River} (Fort Collins, Colo.: Colorado Water Resources Research Institute, Colorado State University, 2005), 16-22.

and Weld Ditch Company’s property, while Ditch Number Four, which took water from the Big Thompson River beginning in 1881, became the Loveland and Greeley Canal. Both served farmers on the outskirts of Greeley, and both were privately financed and, in part, operated though foreign capital from England. Consequently, in just over a decade after its founding, the Union Colony possessed control only over the water which served residents within the town. Nathan Meeker and Horace Greeley had once argued that cooperative irrigation and intensive farming would foster community and financial success. The first ten years of the Union Colony, however, proved that residents were far more invested in their founders’ economic vision than their social one.

Fencing was another issue that illustrated colony members’ flagging commitment to communitarian ideals. According to Horace Greeley’s philosophy, fences erected around private holdings blunted cooperation, and thus colonists initially did not fence their land. At the same time, Nathan Meeker, who agreed with Greeley, also pointed out that farmers could supplement their earnings from agriculture by keeping stock. In accordance with prevailing thought regarding stock-raising, he pointed out that the lands near Greeley were excellent for grazing year-round, and thus colonists would not have to devote resources toward feed. The ideas of both Meeker and Greeley were trumped by reality. By mid-summer of 1871, the overgrazed, and desiccated lands surrounding the Union Colony did not hold the appeal of the green fields and lush gardens of Greeleyites. Cows thus trampled and munched their way through the cultivated areas. The Executive Committee appointed herders to remove the offending bovines, but to little avail. Colonists then approved the building of a communal fence around much of the

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48 Ibid.
49 Greeley’s philosophy on fences can be found in Horace Greeley, *What I Know of Farming: a Series of Brief and Plain Expositions of Practical Agriculture as Art Based upon Science* [Carleton: Tribune Association, 1871], and Meeker’s initial support for cattle grazing is found in Meeker, “A Western Colony.”
colony – approximately 35,000 acres at a cost of $20,000. Of course, fencing costs dulled ongoing efforts to build up the town and provide irrigation. Further, fences irritated stock growers who felt that much of the land being fenced was ideal for grazing. In defiance of colony dictates, some even allowed their cows to winter within the town of Greeley. Moreover, the fence was not completely cattle-proof since it was not legal to place fences across public roads. Apparently, hungry and enterprising cattle interpreted ‘public’ to include them, and they continued to find their way onto colonists’ fields. Union colonists soon scrapped the communal fence in favor of private solutions. In 1874, farmers sold off the cattle-resistant barricade piece-by-piece, to the Poudre Valley Fence Company for less than half the cost of erecting it. Within a few short years, most private holdings in the Union Colony were inexpensively enclosed with the new technology of barbed wire.\textsuperscript{50}

Many other factors dulled the cooperative efforts of the Union Colony. One of those was land speculation. It would have been unreasonable to expect that each Greeleyite would remain and prosper in the new colony. Within a year, many sold their properties and left. Though some of their land was purchased by incoming residents, much of it was acquired by colonists who could afford to add to their land holdings. Consequently, even though small acreage remained the norm in the community, a growing number of individuals acquired larger holdings and the water rights to go with them. Further, since irrigated acreage demanded a higher price than non-irrigated lands, some large holders subdivided their lands to profit from the increase. Founders of the Union Colony purchased its lands in one large block, in part to avoid land speculation. It did not take long for that speculation to appear. A number of other cooperative enterprises envisioned by Meeker and Greeley either failed or never materialized. Among those that failed

\textsuperscript{50} Boyd, A History, 68-73, and “Fence Building” in The Greeley Tribune, 12 April 1871, p. 2.
were a grist-mill, a sawmill, and a cooperative stock growers’ association. Meeker and Greeley envisioned a bakery and a laundry, neither of which were built in the first few years of the colony. Though many of these enterprises eventually appeared in Greeley, they were the result of individual initiative, not cooperative effort.51

Since Greeley was the first Piedmont colony, its experiences provided a template for those that would follow. Within a little more than a year of the town’s founding, five other colonies sprang up in the region. These included Longmont, Evans, and Platteville. According to historian James Willard, there were over 2,700 colonists living in the region in May 1871. Each colony bought land as a block, primarily from the railroads, then sold memberships entitling colonists to land and water rights, prioritized irrigated farming, and promoted various cooperative ventures. And, like Greeley, each colony eventually abandoned the trappings of communalism, but sustained efforts to grow cash crops on small, irrigated acreage. Though other Piedmont towns, such as Fort Collins, Sterling, and Brush did not copy Greeley’s cooperative philosophy, they mimicked its focus on water development and intensive farming. So successful were Piedmont settlers at developing their water resources that water shortages began developing in the South Platte watershed before 1880. Farmers battled for their water rights in courts, while irrigation companies scrambled to build storage reservoirs. By the turn of the twentieth century, Colorado ranked first or second among states in total irrigated acreage, and the Piedmont had developed more of its water resources than any other region in the state. Though few traces of the Union Colony’s social goals could be found by 1900, the Northern Colorado Piedmont had

51 On land speculation in Greeley, see “A Western Colony” and “Land Speculation,” The Greeley Tribune, 5 April 1871.
become a heavily developed agricultural region dominated by fences, small farms, high value crops, well-developed transportation infrastructure, and extensive water development.\textsuperscript{52}

Though the towns of the Northern Piedmont were dominated by small farms specializing in high value crops in the late nineteenth century, the majority of the region was lightly settled. Its primary occupants were cattle. These bovine herds and the primarily Anglo settlers who owned and managed them were relative newcomers to the High Plains. They occupied lands vacated as a result of the decimation of the buffalo and the forced removal of Indians. Buffalo populations had been declining throughout the Great Plains since the 1840s, and did not provide significant competition with herds of cattle for grazing land on the Colorado Piedmont as the region grew.\textsuperscript{53} Indians provided a more significant challenge to the development of the cattle industry. Cheyennes and Arapahoes, along with bands of Utes and Lakotas, continued to hunt buffalo in the region in the 1870s. As buffalo populations spiraled downwards and cattle ranchers stocked the range, some Indians resorted to raiding cattle and occasionally attacking white settlements.\textsuperscript{54} However, with the destruction of Indians’ primary food source, the spread of white settlement, and the development of the reservation system, the range cattle industry was


\textsuperscript{53} According to Richard White, the South Platte River represented the outer periphery of the Southern Plains buffalo herd whose numbers were as high as 3 million in 1870, and it had been completely destroyed by 1875. On this see Richard White, “The Winning of the West: The Expansion of the Western Sioux in the Eighteenth and Nineteenth Centuries,” \textit{The Journal of American History} 65, no. 2 (September 1, 1978): 319–43. However, historians generally view the impact of buffalo on the growing cattle herds as minimal. On the decline of the buffalo see Andrew Isenberg, \textit{The Destruction of the Bison, an Environmental History, 1750-1920} (New York: Cambridge University Press, 2000); On the impact of buffalo on cattle, see Maurice Frink, W. Turrentine Jackson, and Agnes Wright Spring, \textit{When Grass was King: Contributions to the Western Range Cattle Study} (Boulder, Colo.: University of Colorado Press, 1956).

\textsuperscript{54} Frink, \textit{When Grass Was King}, 15–32.
relatively free to supplant the region’s indigenous animals and peoples with imported stock and transplanted humans.55

The cooperative philosophy that characterized the development of colonies such as Greeley was barely visible in Colorado’s cattle industry. Its origins coincided with the Colorado Gold Rush of 1858 when miners and implement dealers trailed cattle with them when they entered the territory. And, whereas Meeker and Greeley sought to dull speculative impulses in their agricultural venture, speculation epitomized the cattle industry. When William Green Russell and his party struck gold near the modern city of Denver in 1858, prospectors hoping to strike it rich soon followed. Retailers trailed behind, hoping to make a fortune supplying miners and settlers. In addition to all manner of tools, newcomers required oxen to move their supplies and, eventually, to plow their fields. Some of those who freighted cattle westward found themselves in Colorado with winter approaching and no suitable shelter for their animals. One such person was Jack Henderson. In the fall of 1858, Henderson was freighting supplies westward from Lawrence, Kansas. He turned his branded cattle loose during the winter and returned the following spring to find them not only alive but in better condition than he had left them.56

Henderson was not the first to discover that large mammals could thrive on Colorado’s open range. Plains Indians encountered this reality upon migration to the region, for buffalo had long thrived on the same grasses which Henderson’s oxen did. Cattle and bison are both members of the bovine family and are ruminants. Both possess an internal organ called a rumen

55 Elliott West argues that overhunting of buffalo on the Colorado Plains had significantly reduced their numbers by 1859. This would have further reduced conflict between cattle and bison; see Elliott West, The Contested Plains: Indians, Goldseekers, & the Rush to Colorado (Lawrence, Kan: University Press of Kansas, 1998), 190–201.
56 Richard Goff, Century in the Saddle (Colorado Cattleman’s Association, 1967), 14-16.
which is a vast fermentation tank that enables them to convert grass – a low grade carbohydrate – into usable protein. Though Plains settlers may not have been able to explain the evolutionary commonalities between bison and cattle, they could certainly understand their practical implications. The vast, imposing prairies could enable the enterprising cattle rancher to strike it rich.\textsuperscript{57}

The biological similarities between bison and cattle were limited, as entrepreneurial ranchers were soon to discover. First, cattle require more grass than bison to produce similar weight gain. Bison consumed in one year what cattle on the same range consumed in a five-month period during the warmer months of the year. In addition, bison evolved to accommodate climatic factors more effectively than imported cattle. In mild winters, common in Colorado, cattle could continue to graze, since snow totals in the region are low, and snow continues to melt even during the colder months. However, more severe winters presented issues of survival. Bison possess a greater degree of insulation than cattle and can survive in temperatures of forty degrees below zero Fahrenheit. Cattle on the other hand, struggle to survive when the thermometer dips to zero degrees Fahrenheit. Further, the larger head and lower profile of bison enable them to find forage through ice and deep snow whereas cattle, with a smaller head and taller stance, struggle to access food under the same conditions.\textsuperscript{58} Amidst their blind optimism, treasure-seeking cattle ranchers from the 1860s through the 1880s were slow to recognize these limitations. Those differences would figure heavily during two 1880s winters.

Greed and speculation, not biological ignorance, however, were the driving factors behind the growing cattle grazing industry in Colorado. As Colorado’s 1859 gold rush brought a


\textsuperscript{58} Steuter and Hidinger, “Comparative Ecology of Bison,” 329-342.
flood of prospectors to the eastern foothills of the Rocky Mountains, those who would supply gold seekers with food and retail goods soon followed. Jack Henderson’s discovery that cattle could thrive on the open range of eastern Colorado opened the doors of commerce for would-be cattle ranchers who hoped to fatten cows with little expense and sell the meat to hungry miners. As news of the demand spread, cattle drovers from Texas, such as John C. Dawson and the legendary Charles Goodnight, drove herds northward to Colorado.59

Satiating the hunger of miners was only the start. The Civil War accelerated events in the West which proved to be bonanzas for the cattle industry in Colorado. The war itself created a market for beef which Colorado cattle helped to meet. The war also enabled Republicans in Congress to aggressively push forward their vision for settling the American West. In order to do this, the federal government forcibly removed Indians who remained on the Plains – including bands of Cheyennes and Arapahos in Colorado - to reservations in Oklahoma and Montana. The federal government, as caretakers of the Indians, signed contracts with cattle ranchers on the Plains to provide beef on the Reservations. At the same time that Plains Indians were removed, the few remaining herds of bison dwindled during the 1860s and 1870s by the combination of new rail lines and settlers heading west. Consequently, cattle could maintain virtually unopposed access to their food source - prairie grasses. With an open range and expanding markets, the stage was set for a Colorado cattle bonanza. At the same moment in history when Horace Greeley and Nathan Meeker were dreaming of irrigated farming abundance in Colorado, cattle ranchers envisioned prairie grass, herds of cattle, and limitless profit.60

No one personified this heady optimism and entrepreneurial spirit more than John Wesley Iliff. Born in 1831 to a Methodist minister, Iliff grew up on a farm in Ohio where he learned how

59 Frink, Jackson and Spring, *When Grass was King*, 35-38.
60 Ibid.
to raise and breed cattle. He moved west to Kansas in 1856 and later joined the throngs of gold seekers heading to Colorado in 1859. After achieving some retail success selling supplies to miners in the fledgling city of Denver, Iliff invested money in land and cattle. Initially, he purchased weak animals at low prices from traders such as Charles Goodnight of Texas, then turned them loose to graze on short prairie grasses on land adjacent to holdings he had acquired northeast of Denver. Typically, he would sell his fattened cattle after two years and make a tidy profit. In 1868, he entered into agreements with Texas cattle barons Charles Goodnight and Oliver Loving to deliver $45,000 worth of Longhorn steers to his Colorado ranches. By 1870, when the fledgling colony movement in Colorado was just getting underway, Iliff’s cattle empire already occupied much of the Northern Colorado Piedmont.\footnote{Tom Jenkins, “Hardworking John Wesley Iliff Became the Most Prominent Cattle Baron in Colorado,” \textit{Wild West}, October 2004.}

While there is no doubt that Iliff possessed great business acumen, timing and ecology also contributed to his success. In 1861, when Iliff launched his cattle business, he had vast resources at his disposal and little competition. With bison in rapid decline and the federal removal of Indians, there was little competition for access to the short grass prairie that made up most of Eastern Colorado.\footnote{Isenberg, 123-163; Agnes Wright Spring asserts that Iliff’s cattle were occasionally rustled but that this had little impact on his holdings; see Frink et al., 345-365.} Iliff also benefitted from loopholes in the Homestead Act of 1862. The legislation enabled settlers in the American West to obtain 160 acres of the public domain for free, if they were able to improve that land within five years. Though settlers were prohibited from obtaining additional land, Iliff contracted with his employees to file for holdings and then transfer title to him after five years. Through this method, Iliff was able to obtain 15,000 acres adjacent to water. Those acres with water access gave Iliff significant power in Colorado ranching circles. Since many ranchers possessed little or no land adjacent to a stream, they
depended on Iliff’s benevolence for access – a benevolence he generally bestowed. And since access to water in this arid region was tantamount to survival for any cattle rancher, Iliff could claim that over 600,000 acres of land were dependent on his holdings.\textsuperscript{63}

For other potential cattle entrepreneurs, Iliff’s success provided a tempting template for their own endeavors. Though prices for steers varied from year to year in the 1860s and 1870s, they were generally a fraction of the money paid for fattened cattle to be shipped to market. During a single two-year period in the 1870s, Iliff purchased one-thousand calves from a Texas drover at seven dollars per head. After the Iliff’s cowboys branded the cattle, they turned the calves loose to mature and fatten on short-prairie grasses, occasionally rounding them up onto one of Iliff’s ranches. Though cattle died due to disease and winter exposure, Iliff managed to keep his average losses to less than 5\% of his total herd. Historian Agnes Wright Spring estimates that, for Iliff, the costs per head of cattle averaged less than one dollar.\textsuperscript{64} After two years, these seven-dollar cattle were rounded up one final time and shipped on the Union Pacific and Kansas Pacific Railroads to slaughterhouses in Kansas City and Chicago for a purchase price approximating $28.00/head. Though this represented an above-normal profit, it was not uncommon. Thus, Iliff could argue without hyperbole that “this (the cattle business) is the grandest opportunity for investment ever offered; there are no uncertain risks attached to the business; the losses are almost nothing, and the profits many times those afforded by other investments.” By the time John Wesley Iliff died in 1878, he had amassed a fortune worth over $1.1 million (over $25 million in 2015 dollars), while providing an example that would inspire hordes of would-be cattle kings hoping to mine the riches of the Colorado Plains.\textsuperscript{65}

\textsuperscript{63} Steinel, \textit{History of Agriculture in Colorado}, 107-165.
\textsuperscript{64} Spring in Frink et al., \textit{When Grass Was King}, 366–382.
\textsuperscript{65} Spring in Frink et al., 334-441; John Wesley Iliff is quoted in Charles I. Bray, \textit{Financing the Western Cattleman} (Fort Collins, : Colorado Experiment Station, Colorado Agricultural College, 1928), 12.
For those seeking riches grazing cattle in Colorado, there were many other sources of inspiration. Greeley resident Jared Brush was one of them. During the 1870s and early 1880s, Brush possessed, on average, four-thousand head of cattle. He owned a ranch along the South Platte River northeast of Greeley and, like Iliff, grazed his steers on adjacent public lands. Brush claimed that any enterprising cattle rancher in the region should be able to realize at least a 40% profit annually.66

Such boosterism was not limited to ranchers on the Northern Colorado Piedmont. James S. Brisbin was the best recognized of the Plains cattle publicists. Brisbin fought in the Union Army through most of the Civil War, and later participated in various Indian Wars in the West from 1868 until his death in 1892. He drew heavily on his experiences to promote the resources of the West. In 1881, Brisbin penned his paean to cattle ranching, *The Beef Bonanza*.67 In it he argued that the Great Plains were perfectly suited for cattle ranching and that they were the richest part of the public domain. Concurring with Iliff and Brush, he opined that grasses of the prairie were limitless and extensive, and that there was no need to feed animals through the winter as prairie grasses were more nutritious than any hay. Brisbin further boasted that any enterprising rancher could realize at least 25% annual profits, and that there was no end in sight to the market for western beef as the population of the United States was increasing rapidly, and Plains cattle ranchers could raise their beef more cheaply than anywhere in the nation. It stood to reason, Brisbin continued, that great profits would also result from increases in land value.

Finally, underscoring the need for urgency, Brisbin argued emphatically that the window of

66 Bray, *Financing the Western Cattleman*, 12.

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opportunity would soon pass. So get your land, hitch your wagons, buy some cattle, and get yourself out to the Plains before it’s too late!\(^{68}\)

The momentum created by the successes of Iliff, Brush, and others, as well as the promotional arguments of Brisbin’s ilk, contributed to a cattle boom on the Colorado Piedmont and throughout the Great Plains from 1881-1886. Prior to this period, Iliff and Brush were exceptions in that their operations were rather extensive. Most ranchers were relatively small, possessing no more than 1,000 head during any single period. Moreover, even the larger players were not seeking outside investment. They grew slowly and incrementally as a result of reinvesting profits into their own businesses. This changed dramatically in a short period. European investors, especially those from Great Britain, eager to take advantage of recent reports on the profits to be made on the Plains, formed corporations and invested heavily in cattle. Similar movements of capital occurred among investors in the eastern United States. Even Colorado ranchers, such as Jared Brush, expanded operations by forming corporations.\(^{69}\)

The numbers bear witness to the boom. From 1873-1879, only five cattle and livestock companies had been formed in Colorado with a total capitalization of just over $900,000. From 1880-1886, over one-hundred-eighty such corporations were formed with total assets of over $75 million. For those invested in the cattle business during this brief period, their hopes were justified as prices for dressed beef exploded. In fact, the three-year period from 1882-1885 witnessed the highest prices ever paid.\(^{70}\) It seemed that there was no end to the beef bonanza that

\(^{68}\) Brisbin, *The Beef Bonanza*.


James Brisbin had proclaimed. However, Colorado, like the rest of the Great Plains was in the middle of a beef bubble, and the bubble was about to burst.

The crash began in 1885, when prices for finished beef dropped for the first time since 1881. In large part, this was due to overstocking of the range. There simply were too many cattle in Colorado – and on the rest of the Plains – for the market to bear. Many cattlemen, believing that flush times were just around the corner, held onto their cattle, hoping for better prices the following year. Then, in 1886, a severe winter pounded the Southern Plains. Though this had little immediate impact on the Northern Colorado Piedmont, it did result in more cattle being driven and freighted into the state from Texas. The following summer was excessively dry throughout the Great Plains. Herds of cattle in the region, already suffering from an overstocked range, reeled in the face of a poor growing season for native grasses on the Plains. Prices for finished beef remained low in 1886, resulting in losses for many Colorado cattlemen in that year, while the most optimistic continued to hold out in hopes of better prices the following year.71

Then the brutal winter of 1886-1887 hit. Temperatures dropped on several occasions to twenty degrees below zero on the Piedmont, and winds seemed to howl incessantly. Several blizzards alternately created layers of snow and ice, resulting in treacherous conditions for cattle that sought sound footing and the ability to forage through the snows to find grasses below. Instead, the thick crusts of ice cut through their legs as they walked and tore at their noses as they tried to forage through the snow. Cattle drifted toward river bottoms seeking food and shelter. Already emaciated by drought and an overstocked range, they died there by the thousands. One observer claimed that a traveler could walk along the north bank of the South Platte River that winter from Greeley to Julesburg walking on nothing but the carcasses of dead cattle. Despite

71 Frink, When Grass Was King, 96-102; Goff, Century in the Saddle, 121-132; Dale, The Range Cattle Industry, 94-101.
this bit of hyperbole, the truth was sobering. Though losses depended on location and the degree of management provided by each operation, cattle losses on the Piedmont averaged more than 15%, while some operations lost over half of their herd. The majority of cattlemen sold large proportions of their emaciated cattle on the market in the spring of 1887. That year prices were even lower than the previous year owing to a glutted market. “The big die-up,” as it was later called, resulted in many cattlemen leaving the industry. For those who remained, the winter of 1886-1887 brought the new and sober reality that cattle ranching on the open range was no longer sustainable. In fact, it never had been.72

In providing an epilogue to the era of the open range on the Colorado Piedmont, it is tempting to foreground the drama of 1886-1887. After all, thousands of frozen cattle possess great narrative punch and allow us to provide a simple bookend to the era of the open range. This would be a mistake. From the time that John Henderson wintered a small herd of cattle near Denver in the winter of 1859-1860, until the great die-up almost thirty years later, the Plains cattle industry was built on visions of a nature without limits. For surely the shortgrass prairies of eastern Colorado were ideally suited for grazing cattle, and their annual replenishment confirmed this.73

Few cattlemen recognized the need for restraint, and none understood the complex web of life on which their livelihoods were based. The buffalo grass that made up most of the region was held together by a complex web of fungi buried in the soil. Heavy grazing such as was occurring in the 1870s and 1880s compacted and diminished the spread of this useful fungi, severely limiting colonization of new grass roots. At the same time, new settlers to the region

72 Ibid.
73 This in fact is the argument of Walter Prescott Webb who opined that cattle grazing “was the most natural economic and social order that the white man had yet developed in his experiment with the Great Plains.” See Webb, The Great Plains, 226.
suppressed natural prairie fires, which they feared would destroy its grasses. They had observed that Indians such as Cheyennes, Arapahos, and others embraced fire; however, believing that Indians were ignorant hunter-gatherers, the newcomers argued that such an approach was surely harmful to prairie grass. In fact, the grass fires which were a regular occurrence throughout the region effectively redistributed healthy fungi and thus promoted the growth of new grasses. If fire and prairie grasses evolved in symbiosis, then grazing and fuel suppression represented a biological disjuncture. Historian James Sherow further points out that the late nineteenth century also witnessed the end of what climatologists refer to as the Little Ice Age, which had begun in the fourteenth century. The end of the Little Ice Age was marked by more frequent droughts and floods, both of which suppressed the growth of healthy grasses on the prairie. In short, cattlemen built an industry based on a resource that they were slowly undermining, and which recent climate changes had rendered unpredictable.74

There were other environmental, social, and political factors which hastened the end of the open range on the Colorado Piedmont. The South Platte River Valley was heavily traveled in the second half of the nineteenth century. It was a thoroughfare for the army, travelers, and settlers. Whether passing through or settling in the region, they were attracted to the few heavily timbered riparian areas. They wasted little time cutting down these scant woodlands, thereby limiting shelter for grazing cattle.75 Further, by 1880, north/south and east/west railroads had been built in the region. Though these enabled cattlemen to freight their product to market more easily, they also brought more farmers into the region who bisected the open range with their homesteads and fences. In addition, cattlemen became victims of their own free market

75 Sherow, The Grasslands of the United States, 63.
philosophy. Viewing prairie grasses and cattle as wealth-building commodities, they milked the resource dry. Furthermore, as the nation’s population exploded after the Civil War, its increasingly urban population demanded more than just beef from this vast region. And the truth was that, with a depleted short-grass prairie, the growth of market farming on the Piedmont, and greater pressure on limited water resources in the region, grazing cattle on the open range was not the most economically efficient way of using the land. The alternating droughts and blizzards that decimated cattle from 1885-1887 were simply the coup de grâce for an industry whose ecological foundation had eroded.

In this sense, the economic vision of Greeley and other colonies on the Northern Colorado Piedmont provided a more sustainable template for long-term viability. With an emphasis on irrigation, water rights, and the growth of cash crops for the market, these agriculturalists were ideally suited to efficiently provide commodities for a growing nation. For cattle ranchers to succeed after 1887, they would have to mimic some of the practices of crop farmers. This meant concentrating their operations on much smaller plots and finding ways to water and feed their animals within them. In addition, just as crop farmers cultivated high value plants, cattlemen would have to pay more attention to breeding stock with the greatest market value. Moreover, as the amorphous open range was displaced by better defined cattle ranches, stock-raisers increasingly relied on crops such as hay and alfalfa to feed their cattle. Some of these would be grown seasonally on their own ranches while others would be purchased from crop farmers.

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76 For an insightful argument on how cattle became commodities during the process of selling them to the stockyards of Chicago see William Cronon, *Nature’s Metropolis: Chicago and the Great West* (New York: W. W. Norton, 1991), 207-259.
There were many specific changes to the cattle industry on the Piedmont after 1887. The starting point was food and shelter. In order to provide these essentials, cattle could not simply be turned out onto the vast open plains; they required careful management, especially during the winter months. Additionally, such oversight necessitated reducing their herds. To provide food for cattle, three items became essential. First, cattlemen initiated the regular practice of cutting hay from their property in the spring. Next, many of them began to grow alfalfa and to utilize or acquire water rights to do so. Since the latter half of the 1870s, stock growers were aware that supplementing natural grasses with alfalfa was effective in fattening cattle; however, few of them regarded this as necessary. After 1887, this all changed. Those whose property abutted water sources or who possessed irrigation rights used portions of this water to grow alfalfa. Those with less access to water purchased alfalfa from farmers and ranchers, while at the same time they sought access to irrigation and water rights. It should come as no surprise that irrigation companies constructed a series of new irrigation canals during the late 1880s and early 1890s. Finally, ranchers put a premium on the ability to fatten cattle quickly and with minimal expense. Consequently, they took advantage of what stock raisers and farmers in the Midwest already knew: namely, that there was no faster and more cost effective feed for finishing cattle than corn. As a result, the stock raisers of the Piedmont, empowered by a growing number of rail lines, came into closer contact with corn farmers in the Midwest after 1887.77

Managing cattle in this more intensive system also required more attention to improving the land and its animals. Prior to 1887, many large cattle operations used the new technology of barbed wire to fence large segments of the public domain to provide exclusive access to native

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grasses for their cows. After 1887, most of the fencing ranchers erected was along the boundaries and within their own properties. Cattle would be fed and sheltered generally from November through April, and the new fencing made this operation more efficient. During the warmer months, cattle ranchers turned their cattle out onto the public domain and meanwhile accumulated hay, alfalfa, and corn for the winter. The more successful and enterprising among them increasingly grew market crops as well, which they sold before rounding up their cattle for the colder months.

Further evidence of this market savvy emanated from breeding practices. Prior to the 1870s, the majority of cattle on the Piedmont were Longhorns. These were noted for their hardiness on the trail and ability to survive extreme conditions. However, they did not produce large quantities of meat, and what they did produce was low-grade. As innovations in transportation and refrigeration gave Americans more access to a variety of foods after the Civil War, consumers were able to effectively snub such inferior meat. Consequently, cattle ranchers on the Piedmont began to selectively breed their herds for quality of meat and to purposefully segregate them from lesser stock. Moreover, as the disasters of the mid-1880s forced ranchers to downsize their herds, it placed an even higher premium on getting top-dollar for every animal.

Philip Boothroyd exemplified many of these changes on the Piedmont. Born and raised in England, Boothroyd immigrated to Larimer County in 1872 and purchased a plot of land near Loveland. During his lifetime, he served as a Justice of the Peace in Larimer County. He was also active in the Farmers Educational and Cooperative Union, which supported the activities of

78 This practice was made illegal by federal law in 1884, though it continued beyond that year. It should be noted that, though this practice engendered conflict amongst ranchers and between farmers and ranchers, there were not any notable examples of range wars such as occurred elsewhere in the West.
80 Frink et al., When Grass Was King, 93-123.
small farmers in Colorado and resisted the influence of corporate agriculture. Though he raised sheep and a variety of crops, cattle were the focus of the majority of his efforts. When compared with the cattle barons of his time, Boothroyd’s ranching activities were small in scale; however, the mundane recordings in his journal – from 1872 through 1933 he kept a diary of his daily activities - reflect the transformations in the cattle industry that were taking place from the 1870s through the 1890s.81

Boothroyd’s 1872 journal entries reflect the experience of someone who was building an agricultural life for himself in a new place. In April and May he recorded planting a variety of crops including cherries plums, beans, beets, melons, and corn. In this, Boothroyd mirrored the activities of his contemporaries in Greeley and other fledgling colonies nearby. He planted hardy crops capable of bringing a decent market price. As might be expected for a newcomer, Boothroyd invested a great deal of time and expense building fences and corrals for his animals. These included horses, sheep, and cattle. Regarding cattle, Boothroyd’s entries are enlightening, partially for what they reveal, but also for what they leave out. In the spring of 1872, he references “looking for cows,” indicating that they had wintered on public lands. His only other daily journal reference to caring for cattle was a May 2 entry in which he records that Blanche had a calf. Boothroyd wrote regularly of building stables and corrals, and we may conjecture that some of these enclosures were erected to care for cattle. But he did not confirm this. In the back of each year’s journal, Boothroyd itemized his daily expenses. While there were numerous entries for food and supplies, there was only one expense in 1872 directly related to cattle. It was an entry of five dollars to feed cows. Apparently, Boothroyd operated under much the same

81 The first available journal for Philip Boothroyd was in the year 1872. I read his journals for the following years: 1872, 1893, 1899, 1906, 1914, 1919, and 1929. See Philip H. Boothroyd, Manuscript Collections, Norlin Library, University of Colorado, Boulder. Hereafter, his journals will be referenced as follows, “Boothroyd, (year).”
philosophy as the larger cattle ranchers in the area: namely, that most of what was necessary to feed and maintain a herd of cattle was free of charge and readily available on the shortgrass prairie.\textsuperscript{82}

Boothroyd’s 1893 journal entries portray a rancher paying much closer attention to managing his livestock. From January through March, his journal recorded the feeding of cattle on a daily basis. He also sold some of his cattle to market in Loveland in February. His chores also included hauling manure – lots of it. On March 9, he referred in passing to having hauled “seventy loads of manure.” When placed alongside his regular entries regarding building stalls and corrals, we must conclude that these loads came primarily from cleaning out these enclosures. Though Boothroyd also raised sheep, he placed greater emphasis on cattle and, given the size differential between sheep and cattle, it follows that the majority of this fecal fertilizer possessed bovine origins. In May, the feeding of stock ended, Boothroyd branded his cattle, and then turned them out to “pasture” through the warmer months. In the meantime, all of that manure was put to use, as Boothroyd occupied his time planting trees and a garden and watering. In fact, no subject received more attention through the summer months than irrigation. This included not only letting water flow to his crops, but also “attend(ing) to ditch.” Throughout the warmer months, Boothroyd emphasized cutting hay and alfalfa and storing it away. In September, he began harvesting crops and storing them away for the colder months. Meanwhile, he initiated purchasing cattle in September, a practice which continued into November when he recorded having “52 head of cattle.” During this period, he commenced feeding cattle again, a practice which received daily attention starting in December. Between

\textsuperscript{82} Boothroyd, 1872.
1872 and 1893, maintenance of stock moved from a peripheral to a central part of Philip Boothroyd’s life. 83

By the turn of the twentieth century, Boothroyd was managing the feeding and care of his cattle even more intensively. His 1899 journal recorded that he had established a corn granary on his ranch and that he was feeding corn to his steers. As his herd had increased to 115 by November of that year, he had more need for feed, so he was buying wheat and oats from other families nearby. He had also begun to emphasize breeding more, specializing in Aberdeen-Angus Cattle, and registering his herd with the American Aberdeen-Angus Breeders’ Association. 84

Boothroyd’s experiences help us to understand the transformation of cattle ranching and, to a lesser extent, of farming in general on the Northern Colorado Piedmont by the turn of the century. Raising cattle required managing every aspect of the herd. It had become necessary for ranchers not only to acquire feed, but also to raise much of it themselves. With smaller herds and tighter markets for cattle, it was essential to be up-to-date on what feeds would most efficiently fatten these animals. In Boothroyd’s case, his choice to cut hay, grow alfalfa and corn, and purchase additional hay and oats from other farmers reflected the research recommendations of agriculturalists at Colorado Agricultural College from the late 1870s through the 1890s. 85 By 1900, the day when herds of cattle could be turned out onto the open prairie for most of the animals’ sustenance had faded away. Further, Boothroyd’s attention to irrigation reflected the additional need for a water supply. The same irrigation ditches that

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83 Boothroyd, 1893.
84 Boothroyd, 1899; though it is unclear when Boothroyd joined the American Aberdeen-Angus Breeders’ Association, he possessed literature from that association dating back as early as 1893.
85 For an example of a Colorado Agricultural College study on the feed value of corn, alfalfa, oats, and beets, see “Cattle Feeding in Colorado” in Colorado Agricultural College Bulletin 34 (1896): 3-36.
supplied his crops also supplied his herd. If successful ranchers needed to manage an animal’s intake, then the same was true of its output. On a tightly managed stock farm, manure was composted and re-purposed as fertilizer for crops. The economics of feeding extended beyond intake and output to the quality of the meat as well. In this, Boothroyd’s choice to select and market a particular breed of cattle known for its attractive features and tasty meat mirrored similar choices his peers were making.

In very telling ways, cattle ranchers at the end of the nineteenth century had learned some of the same lessons that Greeleyites had presumed to be true in 1870. Consider the case of water. In 1870, members of the fledgling Union colony had directed a large portion of their start-up costs for the building of canals. In the two decades following, most of the water in the Cache la Poudre and South Platte River drainages had been appropriated by farmers. Following the disastrous winter of 1886-1887, cattle ranchers increasingly recognized the import of water. If managing cattle required watering their herd, then they needed water rights. An examination of the articles of incorporation for new stock companies on the Colorado Plains demonstrates this transformation. In a random selection of eighteen articles of incorporation, I found twelve from the heady days of 1881-1887, when optimism reigned and prairies grass was presumed to be limitless. Of these, only two mentioned anything about the need to irrigate or acquire water rights. The situation reversed after 1887. For those leaner times, I uncovered six articles of incorporation. Among those, four talk at length about acquiring and using water. Consider the Akin Livestock Company, which formed in 1897 with an initial capital of $60,000. Near the top of the document, the fledgling operation affirmed their purpose: “to purchase, own, construct, maintain, and operate irrigating canals, laterals, and reservoirs for agricultural and stock-raising in purposes.” In a nod to how much of the available water on the Piedmont had already been
claimed, later in the document they affirmed their right to acquire seepage water no longer being used by its original claimants. Cattle are thirsty beasts. By 1900, anyone hoping to make a living by raising these animals would have to redirect water to slake that thirst.86

If cattle ranchers and farmers were two different breeds in 1870, they had come to resemble one another by the turn of the century. Both relied heavily on redirecting nature for profit. This included the development of a vast infrastructure to divert water from its natural courses and then to deliver it to cattle and crops. It involved selectively breeding animals, fruits, and vegetables for their hardiness and market value. Moreover, crop farmers and ranchers recognized their need to cooperate in order to succeed. Cattle provided manure which, when composted, bolstered the soils on which fruits and vegetables thrived. Hay, alfalfa, and corn became indispensable ingredients in the fattening of cattle. In fact, many of the most successful agriculturalists on the Piedmont in 1900 resembled the hybrid operation of Philip Boothroyd. They fattened cattle in winter and raised crops in the warmer months, recycling byproducts such as hay and manure back into their operations. What emerged on the Northern Colorado Piedmont by 1900 was an intensively managed landscape of small farms and ranches where operators incorporated all that nature afforded them to produce for a growing national market.

By 1900, the scientists at Colorado Agricultural College (CAC) were playing an increasingly valuable role in the development of farms and ranches on the Northern Colorado Piedmont. The same development philosophy that brought rails and settlers to the region also fostered universities in the agricultural sciences. In 1862 – the same year in which the Homestead and Pacific Railway Acts were passed – the Republican-led Civil War Congress passed the Morrill Act. Intended to promote the development of the mechanical and agricultural

86 Selected articles of incorporation were examined from the “Western Range Cattle Industry Study, MSS 699,” Special Collections, Stephen H. Hart Library, History Colorado, Denver.
sciences in the nation, it provided land from the public domain to each state that could then be
sold to provide funding for the development of a university. Though the Morrill Act applied to
every state, it had the greatest impact in the West, where few institutions of higher learning
existed, and where farmers encountered a dry climate and mountainous landscape that were
unfamiliar to them. In 1887 and again in 1890, Congress passed legislation which provided
additional funding for agricultural research. The Hatch Act (1887) authorized funds for each
state to establish experiment stations wherein agricultural research could be performed that
would be of practical use to farmers. To be eligible, states were required to match the majority
of federal funds. Finally, in 1890, owing to the need to accelerate the development of these new
institutes of higher learning, Congress passed the Second Morrill Act, endowing additional
monies to all land grant colleges. Though the land grant colleges played a minor role in the
agricultural development of the West during these early years, the seeds of state influence were
planted. They would soon grow.87

Colorado’s land-grant institution was first authorized by territorial governor Edwin
McCork in 1870. The following year, Robert Dazell donated thirty acres in what is today Fort
Collins to build the college. In 1872, the Larimer County Land Improvement Association then
chipped in another eighty acres, contiguous to Dazell’s contribution. The Colorado territorial
government subsequently contributed $1,000 to begin constructing buildings. Efforts by
community members such as the local Grange and others played a role in fund raising and initial

87 Charles Rosenberg, No Other Gods: On Science and American Thought (Baltimore: Johns Hopkins
University Press, 1997), 153-172; Margaret Rossiter, “The Organization of the Agricultural Sciences,” in Alexandra
Oleson and John Voss eds., The Organization of Knowledge in Modern America, 1860-1920 (Baltimore: Johns
Hopkins University Press: 1979) 211-248; The Second Morrill Act also had the social goal of equal access to
college education for blacks. Thus, to receive funds, states had to show that they were not employing racial
discrimination in admissions. This requirement was later modified to allow them to create separate institutions for
blacks, an addendum utilized by states throughout the South; For a larger discussion of the philosophy behind the
land grant colleges see Edward Danforth Eddy Jr., Colleges for Our Land and Time: The Land-Grant Idea in
building construction as well. In 1876, Colorado became a state, and new legislation required the creation of an eight-member board of agriculture to oversee the college. Finally, in 1879, Colorado Agricultural College (CAC) opened its doors to its first five students. Between that year and 1888, the college’s sole professor of agriculture, Ainsworth Blount, performed experiments on wheat, corn, beans, and oats, including the development of new strains of wheat adapted to Colorado’s climate. But, it was not until 1888, when Hatch funds became available to the college, that CAC established a significant footprint in Colorado’s agricultural development. In addition to establishing new experiment stations throughout the state, CAC began hiring specialists in agricultural chemistry, entomology, irrigation, horticulture, and animal husbandry. As an arm of the state, the experiment stations would increasingly perform the roles of researcher, director, and support-staff for the future of Colorado agriculture.88

During the following decade, the Fort Collins Experiment Station functioned primarily to support agriculture that had already established itself in the Piedmont region. Farmers who wanted to improve the quality of their seeds or obtain the latest information on the application of pesticides could send in seeds and pests for analysis. James Cassidy, the staff horticulturalist, provided lists and pictures of common insects, and how and when to apply arsenic-based pesticides such as Paris Green and London Purple to kill the offending bugs. Economic entomologist C.P. Gillette, for his part, printed pictures and descriptions of equipment used to apply pesticides. Irrigation expert Louis Carpenter worked to prevent canal seepage, develop formulas for how much water each farmer was using, and to generally make irrigation more efficient. Agriculturalist Wells Cooke performed numerous experiments on cattle that compared

the feed value of corn, beets, alfalfa, and hay, as well as advised ranchers on whether they should import feed from other states or grow their own. Researchers completed additional work that helped farmers and ranchers identify and eradicate invasive and poisonous plants. In short, the experiment station’s agenda mapped perfectly onto the farmer’s to-do-list. In 1900, the astute observer of the primary experiment station of CAC might conclude that it took its marching orders directly from the local farming community.89

That same observer would be correct, except in regard to one crop: sugar beets. An alternative to sugar cane, which is grown in humid tropical regions, the sugar beet is a subsurface crop which grows well in the mid-latitudes. Though beets are adaptable to a variety of soils, they are best cultivated in regions with plenty of sunshine, and an average temperature of seventy degrees Fahrenheit during the prime growing months of June, July, and August. They require frost-free days throughout those months. Though these climatic specifications are met by many regions of the western United States, one requirement provided a unique advantage for the Northern Colorado Piedmont: available water. Sugar beets need regular infusions of water in the early season, and occasional moisture during the summer. With its well-developed system of irrigation, the Piedmont was uniquely positioned to grow the crop. To do so, however, required significant capital since obtaining usable sugar from the beets necessitated the sort of industrial processing provided by factories, heavy machinery, and a reliable workforce (this will be covered in greater detail in chapter 2). Consequently, the experiment station at CAC found itself

89 On seeds and insecticides, see Colorado Agricultural Bulletins 6 (1888) and 47 (1898). On irrigation, see Bulletins 8 (1890), 22 (1890), and 33 (1896). On cattle feed, see Bulletin 34 (1896). On invasive plants, see Bulletins 23 and 24 (1893).
in the position of advertising an agricultural product that had not yet been grown for profit on the Piedmont, and supporting agro-industrial processes that were yet to appear in the region.90

In the various bulletins and publications of the experiment station between 1889 and 1899, no single crop received more attention than the elusive sugar beet. Agricultural chemists David O’Brine and James Cassidy tested multiple varieties of beet seeds, concluding that, in every case, profitable amounts of sugar could be extracted from each if grown on the Piedmont. O’Brine went on to obtain high quality seeds from a beet processing facility in Nebraska which he was willing to give away to farmers entrepreneurial enough to plant them. As cattle ranchers moved toward more intensive feeding regimens in the 1890s, CAC conducted experiments that measured the value of sugar beets as feed. To demonstrate the profitability of the plant, researchers performed field work that showed the advantages of sugar beets over potatoes – the region’s highest value crop at the time. To encourage the development of a processing plant, agriculturalist Wells Cooke and chemist William Headden wrote an 1898 article arguing that all of the ingredients necessary to build such an operation were already present on the Piedmont. According to Cooke and Headden, there was plenty of cheap operating fuel in the form of abundant coal stocks, easy access to the lime and potash necessary to cultivate and process the beets and, despite concerns to the contrary, available cheap labor. The two concluded in a flourish of hyperbole that “no place where a factory is now in operation presents advantages equal to those possessed by any one of a half dozen localities in Colorado.” To jumpstart the large-scale planting of beets, Cooke used the experiment station bulletin in 1899 to promote a Denver Chamber of Commerce competition which offered cash prizes totaling $1,000 for the best sugar beet crops grown “on a commercial scale.” In its research agenda, as well as its

90 Esther Sanfrieda Anderson “Geography of the Sugar Beet Industry” (MA Thesis, University of Nebraska, 1917), 16-25.
unabashed promotion of a single crop, the experiment station planted seeds for an industry that would germinate with unprecedented ferocity in the years to come.  

How then do we evaluate the role played by Colorado Agricultural College and its research station in the development of Piedmont agriculture prior to 1900? As scientists working in agriculture, a field struggling to gain respect in the scientific community, they hoped to conduct groundbreaking research; however, limited funds and the immediate concerns of farmers forced them to focus most of their research on applied agriculture rather than theoretical science. This reality was underscored by the fact that the Colorado State Board of Agriculture oversaw the activities of the experiment station, which influenced its agenda as a result. Thus, any synopsis of its work would have to conclude that the station provided support and expertise to diverse, market-based agriculture on small farms, efficiency-driven aid for utilizing the region’s water resources, and support for the transition of the region’s cattle industry from open-range grazing to intensive feeding. Sugar beets provide the lone exception to this analysis. Since, by their very nature, sugar beets required heavy capital investment in factories, equipment, and labor, the experiment station’s push for the creation of a new industry amounted to support for commercial farming and greater industrialization. In the first decade of the twentieth century, that support would bear unforeseen fruit.

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91 Some examples of beet research and promotion include Colorado Agricultural Bulletins 7 (1889), 11 (1890), 14 (1891), 23 (1893), 43 (1898), and 51 (1899).

92 For more on the debate between applied and theoretical science in agriculture in the late nineteenth century, see Alan I. Marcus, *Agricultural Science and the Quest for Legitimacy: Farmers, Agricultural Colleges, and Experiment Stations, 1870-1890*; Rosenberg, *No Other Gods*, 153-172; Eddy, *Colleges for Our Land and Time*, 46-112. While scientists at Colorado’s experiment station may have desired to do more theoretical work, it is clear that their research agenda was largely governed by immediate needs.

93 Historians disagree regarding whether experiment station scientists knowingly contributed to large-scale, industrial agriculture. Rosenberg argues that agricultural scientists supported the idea of the family farm, but practical concerns pushed them to work with more heavily capitalized farmers and with agro-industry, resulting in an unavoidable inconsistency between their social goals and the needs of their work. Hightower argues that land grant college support of agro-industry has been more conscious and calculated. See Rosenberg, *No Other Gods*, 153 – 172; Jim Hightower and Agribusiness Accountability Project, *Hard Tomatoes, Hard Times,: The Original Hightower Report, Unexpurgated, of the Agribusiness Accountability Project on the Failure of America’s Land*.
There were no factors, however, that foretold any significant change in Piedmont agriculture for the new century. The region displayed all of the characteristics of intensive cultivation. By this I mean that the region used all available resources for market production.

By the turn of the twentieth century, 90% of improved agriculture in the region was irrigated, made possible by the construction of canals, ditches, and storage reservoirs. Cattle ranchers largely used locally grown crops to feed their cattle in the winter months and crop farmers took advantage of manure produced by cattle and other domesticated animals. An aerial view of the Piedmont in 1900 would have revealed an extensive network of irrigation works coursing through clearly defined small farms, and several well-laid-out communities, all tied together by a functional transportation network. As evidenced by how thoroughly the region had appropriated its available resources, land use on the Northern Colorado Piedmont exemplified intensive cultivation.94

On the contrary, the region did not yet display many of the characteristics of industrial agriculture. Land holdings were still relatively small and there was no significant push toward consolidating land into fewer hands. Further, the outside observer would find little evidence of corporate farming, especially of the kind that was occurring in California at the same time.95 In addition, though farmers and ranchers were producing the majority of their products for the market and buying consumer goods from elsewhere, they still retained a great deal of autonomy over production. Finally, most farmers employed little if any outside labor on their lands. Certainly, there was no permanent underclass of marginalized farm labor.96

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95 For an example of corporate farming in California in 1900, see Stoll, The Fruits of Natural Advantage.
96 According to Wyckoff, in 1900, the Northern Piedmont was dominated by small, owner-operated farms. See Wyckoff, Creating Colorado, 124–133.
It would seem that half of the goals of the original Union Colony had been realized on the Piedmont. Though few elements of its communitarian goals remained intact, its economic objectives were largely met. When Nathan Meeker and Horace Greeley proposed the colony, they sought to create small farm holdings which produced for the market, and utilized irrigation to make agriculture pay. In most respects, this effectively portrays Piedmont agriculture in 1900. It’s a portrait that would not hold in the years to come.
Chapter 2: From Intensive to Industrial: Corporate Agriculture Comes to the Piedmont, 1900-1930

Piedmont agriculture in the late nineteenth century possessed most of the trappings of intensive cultivation, but few markers of industrial agriculture. Intensive cultivation involves the use of capital and technology to increase yields of high-value, market crops on existing land. Because the goal is for maximum production and high returns without expanding onto new lands, intensive cultivation implies that farms specialized in one or very few valuable crops that were calibrated to the climate and soils of a given region. On the Piedmont, prior to 1900, those crops included beans, wheat, potatoes, and a variety of small grains. Specialization did not involve growing only one crop, or monocropping; it simply meant that farmers oriented their operations around growing one or a small number of crops on which much of their income was based. For example, some Piedmont growers raised livestock and alfalfa primarily to support the production of the potatoes on which much of their income depended. Intensive cultivation implied small acreage since farmers focused on making existing land productive. This was especially true on the Piedmont where most early settlers acquired fewer than 100 acres initially and where their ability to expand was limited by their access to inadequate supplies of irrigation water. Though intensive farming could be lucrative, as the orchards developing in California at the turn of the century demonstrated, small acreage generally placed a ceiling on possible returns.¹ On the Piedmont, where intensive agriculture was the rule by 1900, few farmers were wealthy, though incomes compared favorably with most farmers in the West at the same.²

¹ The concept of intensive agriculture is adapted from Steven Stoll. See Steven Stoll, The Fruits of Natural Advantage: Making the Industrial Countryside in California (Berkeley: University of California Press, 1998), xii–xvi.

² During a brief period from about 1896-1902, farm incomes declined on the Piedmont and some farmers moved out of the region. This was largely due to the shock waves of the Depression of 1896 which impacted farmers throughout the United States. But, the general trend toward higher incomes resumed and greater productivity resumed quickly in the early twentieth Century.
The march toward industrial agriculture on the Piedmont largely began in 1901 when Great Western Sugar built its first factory to turn sugar beets into beet sugar. Industrial agriculture is typified by dependence on heavy capital inputs, a well-defined division of labor, and increased interdependence between regional economies, businesses, and state agencies. To process sugar beets into refined sugar, huge capital sums were necessary to build factories and pay factory laborers. Since modest Piedmont farmers did not possess the necessary finances, that capital originated from outside the region. The division of labor extended beyond workers in the factory to laborers in the fields, since sugar beet cultivation was a very labor intensive operation. Those workers had to be imported since few laborers were available on the Piedmont, and the largely Anglo local population was unwilling to perform the arduous physical tasks necessary to cultivate and harvest sugar beets. Because of the peculiarities of the plant, mechanized cultivation and harvesting did not begin in any substantial way until the 1940s. Further, though sugar beet agriculture had little impact on farm ownership, the choice farmers made to grow beets placed them within a larger division of labor – as growers. Under this system, tasks that were formerly performed completely or in part by farmers - seed breeding and selection, cultivation, harvesting, crop sales and marketing – became the responsibility of Great Western. Piedmont farming interdependencies also extended to state-sponsored science as Great Western utilized agencies of the United States Department of Agriculture (USDA), and agricultural colleges to conduct research aimed at expanding yields and lowering costs. On the Piedmont, the transition from intensive cultivation to industrial agriculture was activated by the beet sugar industry, and thus this chapter will examine the dynamics that enticed that industry to the

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3 Stoll, xii – xvi.
4 On the factors that influenced industrial agriculture in the United States, especially in regard to mechanization, see Deborah Kay Fitzgerald, Every Farm a Factory: The Industrial Ideal in American Agriculture, Yale Agrarian Studies Series (New Haven: Yale University Press, 2003).
Piedmont, the factors related to its explosive growth from 1900 to 1930, and how this impacted the relationship between farmers, industry, and the land which both depended on.\textsuperscript{5}

Sugar beets are an ideal industrial crop, as demonstrated by their Piedmont history from 1900 to 1930. Since the late 1880s, newspapers, local boosters, a large constituency of farmers, and Colorado Agricultural College (CAC) had been publishing articles demonstrating the suitability of sugar beets for the Piedmont, and seeking investors with the capital to build beet sugar factories. A single factory required a multi-million dollar investment, and a pledge by local farmers that they would plant sufficient acres in sugar beets to make that new factory profitable. Potential sugar beet entrepreneurs also had to invest in finding field and factory laborers, and paying factory workers before any sugar was sold. Further, sugar beets were rarely eaten in vegetable form and so they could not be sold directly to consumers from the farm. Profit required processing, and beet sugar entrepreneurs had to invest in factories and labor long before a saleable product hit the market. Large initial investment was a pre-requisite for the beet sugar industry. As the Colorado Piedmont became the most significant beet sugar producing region of the United States from 1900 to 1930, it was characterized by heavy capital investments.

One might expect that the explosion of capital brought to bear on Piedmont agriculture by Great Western would have noticeably altered relationships with the land. Surprisingly, the beet sugar industry largely supported the most sustainable practices already practiced by farmers in the region. Sugar beets extract a heavy toll on the soil and cannot be grown successfully over the long term without persistent attention to soil maintenance. Thus, Great Western encouraged sugar beet growers to continue and expand their practice of adding nitrogen to the soil by

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\textsuperscript{5} Later chapters will analyze other aspects of industrialized agriculture. Chapter three examines farm laborers. Chapter four looks the relationship between the sugar beet industry and the state-sponsored science. Chapter six analyzes the development of chemical agriculture on the Piedmont.
composting livestock manure and employing nitrogen-fixing legumes to do the same. Great Western Sugar – along with experiment stations at CAC – regularly published reports on how to conserve soil, utilize manure, and fine-tune crop rotations. For the sugar company, this made financial sense. With millions of dollars invested in factories and equipment, it could hardly afford otherwise. Had it encouraged farmers to rotate fewer crops or get rid of their livestock in favor of devoting more acres to beets, it would have undermined the soil’s productivity. Further, since Great Western did not own the land on which beets were farmed, growers could refuse to plant them if they were convinced that the company had no interest in their long-term viability. In short, under conditions such as were present on the Piedmont from 1900 to 1930, capitalism largely depended on a relatively healthy and sustained agriculture.⁶

There were limits of course to free market support of sustainable agriculture on the Piedmont. We should not make ecologists out of Great Western Sugar employees, or trace the lineage of organic farming through sugar beet growers. Both were oriented toward the market, and they were quite willing to utilize all proven inputs to grow the highest possible yields of crops. Even thoughtful crop rotation attracted insects to crops in unhealthy numbers and neither Great Western nor its growers were averse to using toxic chemicals on these infestations. In addition, farmers and Great Western sometimes encouraged the overuse of irrigation water in order to produce higher crop yields, occasionally resulting in flooded or salty lands. But Great Western and its growers were motivated by growing and processing the most lucrative crop available to them. And that meant that the company and its growers depended on the long-term productivity of the land – and on each other.

Outside capital resulted in outside control. In becoming growers, farmers willingly relinquished much of their former autonomy over their farms to Great Western. Growers relied on Great Western for beet seeds, laborers, the processing of the crop, sales to distributors and consumers, and knowledge of sugar markets around the world. The heavy investments of outside capital that defined industrial agriculture, necessitated the creation of distinct divisions of labor. Piedmont growers willingly relinquished some of their autonomy over their farms. To a large degree, they were simply following the philosophy that motivated initial settlement. At the heart of the philosophy of intensive cultivation was maximizing profit and production on small acreage. By 1900, Piedmont farmers had become relatively successful and, owing to the highly cultivated nature of their farms and the value of irrigation water, their lands had become valuable. Growing a new crop that promised higher profits and a continuation of intensive cultivation fit well with the mode of farming they were already practicing. And it was a small trade-off for some of their autonomy.

The origins of the transformation to industrial agriculture are found in a rather odd looking vegetable called the sugar beet. Off-white in color, shaped like an overgrown carrot, and possessing a taproot that extends several feet below its body, this tuber provided the only concentrated source of processed sugar that could be grown outside of tropical and subtropical climates. Though beets are adaptable to a variety of soils, they are best cultivated in regions with plenty of sunshine and an average temperature of seventy degrees Fahrenheit during the prime growing months. They require frost-free days throughout those months, though beets thrive when cool nights alternate with warm days. Though these climatic specifications are met by many parts of the western United States, one requirement provided a unique advantage for the Northern Colorado Piedmont: available water. Sugar beets require regular infusions of water in
the early season, throughout the summer, and into the early fall. With its well-developed system of irrigation, the Piedmont was uniquely positioned to grow the crop.\(^7\)

Given these advantages, why had farmers not grown the crop on a large scale prior to the twentieth century? The answers were rooted in the brief history of Piedmont agriculture and in the capital necessary to make sugar beet agriculture pay. Unlike the market crops cultivated by Piedmont farmers in the late nineteenth century, sugar beets required more processing to extract a usable product for the market. It was necessary to raise large sums of capital to build a factory and purchase machinery that could perform the physical and chemical acts necessary to transform a rather innocuous vegetable into sugar. The problem was not just one of capital, but of human labor as well. Those who invested in sugar beet factories needed beets to process, and so a sufficient number of farmers would have to agree to grow a crop with which they had no experience. Finally, to facilitate the processing of sugar beets, factories needed workers. Most locals were already engaged on their own farms and ranches, and few were willing to perform the arduous hand labor required by sugar beet agriculture.

Despite what the region lacked in capital, labor, and knowledge, the Piedmont did not lack for beet boosters prior to 1900. The Experiment Station at CAC was the most prominent among them. During the 1890s, the experiment station conducted various studies that established that the soils and climate of the Piedmont were capable of producing high quality beets whose sugar content and sheer tonnage per acre could compare favorably with any region on earth. Experiment station publications were careful to point out that the Piedmont region also possessed abundant stocks of lime, potash, and coal, all necessary for processing sugar beets. The territorial and state governments of Colorado (Colorado became a state in 1876) also

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\(^7\) Esther Sanfrieda Anderson “Geography of the Sugar Beet Industry” (MA Thesis, University of Nebraska, 1917), 16-25.
played large roles in boosting sugar beets. In 1872, the territorial legislature entertained a bill that would have paid a subsidy to any organization that built a factory capable of refining two-hundred barrels of sugar per day. It failed by one vote, largely over financial concerns. Then, in 1899, the Denver Chamber of Commerce financed a competition which offered cash prizes totaling $1,000 for the best sugar beet crops grown “on a commercial scale.” It was prominently advertised in several experiment station publications. As with local boosters, the state legislature sought industries that could bolster the state’s economy and attract new settlers.

Efforts to secure a sugar beet industry on the Piedmont finally hit their mark in 1900. In 1898, Charles N. Cox, a Grand Junction businessman with interests in cattle and mining; Charles Boettcher; a hardware merchant, and John Campion, president of the Denver Chamber of Commerce, took advantage of an offer made by farmers in the Grand Valley, on the western side of the state. Boettcher and Campion agreed to finance and operate a beet factory in the Grand Valley in exchange for a guarantee that farmers there would plant 3,000 acres in sugar beets. When the venture flagged due to farmers planting and harvesting fewer beets than investors originally anticipated, Cox, Boettcher, and Campion shifted their efforts to the Northern Colorado Piedmont town of Loveland.

Past experiences with sugar beets made Loveland an ideal choice. In 1898, the Colorado and Southern Railroad offered free sugar beet seed to farmers in that area, hoping to take advantage of shipping the beets that were grown and any future business that might result. Since the Colorado and Southern Railway operated between Denver and Wyoming, traveling through the heart of the Piedmont, it was ideally situated to provide the freight needs of sugar beet

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8 Some examples of beet research and promotion can be found in Colorado Agricultural Bulletins 7 (1889), 11 (1890), 14 (1891), 23 (1893), 43 (1898), and 51 (1899).
9 May, Great Western Sugarlands, 4-14.
agriculture. To facilitate beet growing, James Cook of CAC visited the Loveland area to promote sugar beets and demonstrate growing techniques. Their efforts paid off as the Colorado and Southern Railway shipped nine carloads of Loveland beets to a processing plant in Nebraska that fall. Factory analysis of the beets concluded that they contained an average of 15.4% sugar, the highest for any beets produced in Colorado that year. It did not take long for Loveland residents to clamor for a factory.  

Taking advantage of this beet fever, Boettcher, Campion, and Cox took on several other investors and formed the Great Western Sugar Company in February of 1901. Loveland promoters had agreed to supply the new beet sugar factory with contracts from farmers. Under the agreement, area farmers collectively promised to provide at least 3,500 acres of beets each year for a minimum of three years, while the Loveland community would donate 1,500 acres to build the beet processing factory and provide an $8,000 signing bonus to Great Western. Planting commenced in April and harvesting in early October, with the factory completed that same month. Great Western was able to secure factory labor from the Kilby Manufacturing Company in Nebraska, one of the few companies in the United States with experience installing and operating the specialized equipment for processing sugar beets. By the close of the season in March 1902, Great Western had sacked almost 140,000 bags of sugar and netted a profit of $75,000. The sugar-rush was on. The industrialization of the Northern Colorado Piedmont was underway.

In the span of just over two years, from 1901 to 1903, five additional companies built beet sugar processing facilities on the Piedmont, using much the same template as the one established at Loveland. In Greeley, Longmont, Eaton, Fort Collins, and Windsor, local boosters

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10 Ibid, 16-18.
attracted willing investors from outside their immediate vicinity to invest in a sugar plant. Eager capitalists were then willing to construct and operate a facility once locals had secured multi-year contracts with farmers for a minimum number of acres planted in sugar beets (generally between 4,000 and 6,500 acres), a guaranteed supply of water for beet processing, the donation of a suitable site on which to build the factory, and a railroad right of way for transporting beets to factories and processed sugar to market.\(^\text{12}\)

Regional publications played an important role in the development of the sugar beet industry in the region as well. In 1903, the Denver-based publication *Ranch and Range* put together a 28-page spread on Morgan County, a region bisected by the South Platte River and dominated by irrigated agriculture. In extolling the virtues of the land, the author claimed, “the soil is dark, sandy loam, of more than fifty feet in depth, and properly cultivated is inexhaustible.” He went on to point out that, because of the quality of the soil and the gentle slope of the terrain, irrigation is “a matter of pastime rather than labor.” Moreover, abundant irrigation and water rights were already available owing to ditches already dug and reservoirs constructed that were capable of providing over 100,000 acre feet of water. The author further argued that Morgan County possessed more fertile land than Greeley, the most prosperous agricultural center on the Piedmont.\(^\text{13}\) Though the article extolled the virtue of agriculture in general, the author was quite conscious of the growth of the beet sugar industry in particular, emphasizing the land’s suitability for beets. He pointed out that Fort Morgan investors planned to build a beet sugar factory in 1903, capable of handling 1,200 tons of beets daily and that one farmer, a Mr. Hurley, had already netted a profit of $100 per acre while raising thirty tons of


\(^{13}\) *Ranch and Range* 3, no. 12 (1902): 5-33.
beets the previous season.\textsuperscript{14} And farmers should not be concerned about labor as, according to the author, numerous Russian immigrants already lived in the region in their own houses, and were accustomed to cultivating beets. The author optimistically predicted that that sugar beet agriculture would result in land values doubling and county population quadrupling in the next eighteen months.\textsuperscript{15}

Knowledge of sugar beet farming came from various sources, including factory proprietors. As Great Western Sugar began its operations in Longmont, the Agricultural Superintendent of the factory, C.S. Faurot, prepared a pamphlet for distribution to potential growers in the area. It was published by the local Longmont newspaper. His introduction mimicked the efforts of boosters in Fort Morgan when he stated that “there is no crop planted on the soil that will bring the farmer greater returns for the time and money invested than the beet crop.” Faurot went on to provide advice on how to select lands for planting a sugar beet crop, soil preparation, plowing, cultivation, irrigation, fertilizer, harvesting, crop rotation, and the profits a farmer might expect from following his advice.\textsuperscript{16}

Similar help was available from the Colorado Agricultural College Experiment Station. During Great Western’s initial decade of operation, CAC agronomist W.H. Olin conducted experiments on various methods of cultivating sugar beets, and agriculturalist A.H. Danielson provided advice on the types and amounts of fertilizer farmers should use on their beet crop. Chemist William Headden analyzed the development of unwanted nitrates in the soil, and entomologist C.P. Gillette helped farmers identify and exterminate common insect enemies of

\footnotesize{\textsuperscript{14} The author’s boasts were a bit premature, as the two beet factories in Morgan County, at Brush and Ft. Morgan, were not completed until 1906.  
\textsuperscript{15} \textit{Ranch and Range}, 5-33.  
\textsuperscript{16} C. S. Faurot, \textit{A Practical Talk to Practical Farmers on Sugar Beet Culture} (Longmont, Colo: Longmont Call Press, 1903).}
the sugar beet. And, as the sugar beet industry sought a market for the byproducts of their beets, CAC offered encouraging advice to cattle ranchers on how to utilize beet pulp to fatten their animals. In fact, no other crop or agricultural industry received as much attention in CAC bulletins as sugar beets.17

The Bureau of Plant Industry (BPI), a division of the USDA, also carried on regular correspondence with Great Western Sugar during its infancy on the Northern Colorado Piedmont. Of particular concern were seeds. In January and February of 1903, while the Loveland factory was in the midst of turning beets into sugar, the BPI sent three separate letters to A.V. Officer, the General Manager there. The first letter asked whether Great Western had conducted experiments on disinfecting seed to prevent the “introduction and spread of beet diseases such as blights, rots, etc.” A follow-up letter in February offered the agency’s help in testing seed. That same month, BPI wrote to request that Great Western distribute literature to growers on methods for early seed germination in the spring. The following February, the USDA requested that Great Western provide the agency with one-hundred pounds of each of the varieties of seeds it used so that experiment stations throughout the country might test them for sugar content and purity.18

Though these communications may seem mundane, they highlight multiple issues that help us to understand the processes that transferred agricultural control from farmer to industry. The state played an important role here. First, the fact that USDA employees were writing directly to Great Western emphasizes that the agency acknowledged that the company, not the

17 See Colorado Agricultural Bulletins 73 (1902), 98 and 102 (1905), 107 and 115 (1906), 121 (1907), 149 (1909), and 183 (1912).
18 USDA Bureau of Plant Industry, Washington D.C. to AV Officer, Great Western Sugar, Denver, 9 January 1903, 5 February 1904, and 24 February, 1904, Great Western Sugar Collection, Loveland Museum Archives, Loveland, Colorado (hereafter Loveland Archives), Box 1, “January 1903” and “February 1904.”
farmer, controlled which seeds would be planted. In truth, growers who contracted to plant sugar beets agreed to buy seed from Great Western. At the time, domestic beet seeds were only cultivated experimentally, with the principal commercial stock being imported from Germany.\textsuperscript{19}

Prior to the advent of sugar beet agriculture on the Piedmont, farmers generally selected seeds from the most productive crops of the previous season to plant the following year. The nature of the industry and the language of grower contracts conspired to remove farmer autonomy in the planting of their most valuable crop.

Similarly, the Experiment Station at CAC prioritized sugar beet research amongst its many projects. In privileging this crop over others, the college made a conscious decision to support a form of agriculture that required large infusions of capital, plenty of extra-local labor, and factories to manufacture a product. Moreover, as decisions about production would increasingly be made by Great Western into the future, CAC’s support of sugar beet agriculture implied the need to communicate more with corporate representatives and less with growers, essentially distancing Colorado’s only land grant college from direct connections with the small farmers central to its primary mission.

We can see a similar transformation taking place among farmers as well during this period as Great Western pulled decisions about labor and harvesting out of the hands of growers. For cultivation and harvesting, growers relied on masses of non-local field laborers. Without the resources to find workers, growers became tethered to Great Western’s ability to locate them. In addition, Great Western gave growers separate windows in September, October, and November in which to harvest their beets. This was based on the ability of the company to transport, store,

\textsuperscript{19} For examples of specific types of seeds and their origin, see Henry Dahlberg, “Beet Seed – Twenty Five Years Ago and Now,” Through the Leaves (\textit{hereafter TTL}) 26 (1938): 112-114.
and process the beets. Harvesting timing then became a function of available labor and factory capacities.²⁰

The transference of agricultural power surfaced most clearly through grower complaints. In March 1903, multiple growers in the Loveland region wrote pointed letters to Great Western arguing that the company had not fulfilled its obligations. Some complained that the promised labor force needed to cultivate and harvest was either insufficient or poorly timed to meet the demands of cultivation. Others argued that they were forced to harvest their beets too late in the season. Consequently, early frosts destroyed portions of the crop. They posited that, if they were allowed to harvest earlier, their economic return would have been greater.²¹

When analyzed individually, the foregoing letters, experiments, articles, and directives offer only minimal evidence of agricultural transformation on the Northern Colorado Piedmont. When examined together, however, they offer substantive evidence of industrial processes taking hold. Articles that touted the benefits of purchasing sugar beet acreage resulted not only in more farmers, but a larger network of growers who contracted acreage with Great Western. In addition, the sugar beet experiments conducted by Great Western, CAC, and the USDA may not have originated from the same motives, but they resulted in both more sugar beet acreage and substantial increases in Great Western’s sugar production. Even farmers themselves contributed to this process. Though they were not coerced to grow for Great Western, the very fact that so many of them did – and gained financially in the process – allowed Great Western to possess more decision-making power over the Piedmont landscape.

²⁰ Eventually, GWS and growers agreed on contracts where growers who agreed to silo their beets until the factories were ready for them would be paid more per ton of beets harvested. The onus to build and maintain such silos was on farmers.
²¹ For example, see James Burke, Loveland, Colorado, to Great Western Sugar, Loveland, March 1903, Loveland Archives, Box 1, “March 1903.”
To understand the early workings of industrial agriculture on the Piedmont completely, we must walk away from the fields for a while and catch a glimpse of the process by which sugar beets became sugar. There were three salient points that must be grasped within this process. First, Great Western’s sugar processing facilities did not differ significantly in substance or appearance from factories that turned iron ore into steel. The raw product, sugar beets, entered the factory in a form that possessed little market value, and they exited the factory in an altered form that was ready for consumption. Second, the transformation was a chemical one. Wage laborers utilized complex machinery along with natural resources such as coal and lime, as well as synthetic products including various acids in a multi-stage process to create refined sugar out of an unremarkable vegetable. Finally, the factory’s existence punctuated the fact that beet sugar possessed no marketable geography. Once processed, beet sugar looked no different than cane sugar whose semi-tropical origins were familiar to most consumers. By contrast, sugar beets were grown, transported, processed, and packaged within a radius usually of less than fifteen miles. Unless the consumer lived on the Piedmont, there was neither opportunity nor reason to attach the end product to a particular locale, let alone to envision the individual grower. The same processes that revealed a consumer product rendered the growers, the wage laborers, the vegetable, and its geography anonymous. Now, let’s take a closer look at how this was accomplished.

The harvesting and transportation of sugar beets was a labor-intensive process. Typically, the beet harvest began during the last week in September or the first week in October. Contract laborers - most of whom had signed contracts to thin, cultivate, and harvest beets the previous spring – labored until all of the region’s beets were harvested, a process generally completed by mid-November. Growers used machines and horses to loosen the soil around the
beets. Laborers then pulled the beets by hand and cut the tops off using a ten-inch-knife. Laborers then placed the beets in piles for transport, while the tops were set aside for use as silage. Most growers used the fermented silage to feed cattle and other farm animals. Laborers then shoveled the beets into wagons for transport either directly to a factory or to be loaded onto rail cars. Each grower was assigned a number that they affixed to their wagons. They unloaded their sugar beets at specially designated dumps. These consisted of long runways that sloped gently onto elevated platforms. After dump operators weighed the beets, a team of horses pulled farmers’ carts up the runway onto a platform where farmers unloaded their beets into a hopper that led either directly into a factory or into rail cars where they would be transported to a factory.²²

When the beets arrived at the factory, almost all efforts were bent on transforming the sugar beet into sugar. The beets entered the factory via water flumes and were then dropped into washers. After the removal of dirt and other foreign matter, an elevator transported beets to the top floor of a four-story factory where scales weighed them again and automated knives mechanically sliced the beets into a uniform shape and size. The sliced beets were referred to as cossettes. The cossettes were then elevated by machine and dropped into a diffusion tank where sugar was extracted by pouring hot water over them in a process called osmosis. By this point, the original beet no longer appeared in form or substance as it did before entering the factory.²³

The remainder of the process required knowledge of machinery and chemistry possessed neither by the typical beet farmer nor by the factory laborer. The extracted sugar in the form of a juice required purification. This involved several infusions of lime, carbon dioxide, sulfur

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²³ “Manufacture of Beet Sugar,” *TTL* 1, no. 9 (1913): 11; *TTL* 1, no. 10 (1913): 22; *TTL* 1, no. 11 (1913): 18.
dioxide, and gas produced from limestone. Sugar boilers then reduced the juice down to a heavy syrup in a series of evaporation machines. It was further reduced to sugar crystals in a vacuum pan, which then spit out its contents into a centrifugal machine. This machine whirled the sugar crystals at high speeds, causing most of the remaining unusable syrup to be caught in filter screens, while the usable sugar was washed with water. This sugar was then placed onto heated conveyor belts equipped with screens to eliminate any undesirable clumps that may have formed during processing. The dry, screened sugar was then weighed, sacked, and ready for market.24

In addition to machinery, chemistry, and wage labor, the process of turning sugar beets into sugar required two other important inputs and produced several byproducts. The same trains that transported beets to factories also brought the coal and coke that was necessary to operate the machinery. In addition, irrigation canals not only provided the water required to grow beets but also the water necessary to process them. Further, though manufacturing refined sugar was the primary objective of Great Western, it also yielded profitable byproducts. During diffusion, pulp was separated from the sugar, and the remaining pulp provided an excellent feed for fattening animals, particularly cattle. Later in the process, molasses formed from the portion of syrup that could not be rendered into refined sugar. Though not as useful in large quantities as beet pulp, molasses could be employed as an additive in animal feed.

Great Western consolidated and grew in the early twentieth century at an astonishing rate. In 1901, Colorado’s fledgling sugar beet industry caught the eye of the sugar trust, headed by Henry Havemeyer, one of the richest men in America. Havemeyer’s American Sugar Refining Company controlled almost two-thirds of all of the cane sugar refined in the United States. By 1901, sugar beets were supplying seven percent of the nation’s domestic supply. Fearing that

24 Ibid.
beet sugar could threaten his stranglehold on the industry, he employed several strategies to acquire each of the Piedmont’s factories.²⁵

Havemeyer’s initial strategy was simply to purchase each factory. When owners refused to sell, he resorted to underselling Colorado beet sugar in its consumer markets. Since the Plains and the Midwest were the most important markets for Piedmont sugar companies, The American Sugar Refining Company flooded those regions with cane sugar at well-below market value. Knowing that consumers would purchase the cheap cane sugar, many retailers refused to even carry the Piedmont product since it was being undersold by an average of twenty percent. Beet sugar investors such as Charles Boettcher, who controlled the Loveland factory, countered by selling sugar in markets further east. However, he was aware that such a strategy would only work once and that Havemeyer would counter it the following year. Other factories attempted to store their sugar rather than sell it at below market rates. This strategy could only be temporary though, since none of the Piedmont factories had enough capital to hold onto their sugar for more than a season. Havemeyer put additional pressure on factories by filing articles of incorporation to build beet processing factories near existing ones. If Havemeyer built these factories, he would then pressure local growers to sell their beets to his factories, presumably at a better rate than they had received from the local one. This was more pressure than any of the factories could withstand, and by the end of 1903 all six factories – located at Ft. Collins, Longmont, Greeley, Eaton, Windsor and Loveland - had sold a controlling interest in their companies to American Sugar Refining.²⁶

²⁵ Sabin, The Colorado Beet Boom, 20-21; May, Great Western Sugarlands, 44-60.
Initially, Havemeyer was content simply to own companies that would otherwise have been competition. Consequently, he appointed a Colorado native, Chester Morey, to oversee his financial interests there, while allowing each of the six factories to be managed independently. But problems with this arrangement mounted from the start. Growers clashed with management in 1903 over prices paid for beets, and the ongoing insecurity that there would not be enough laborers for cultivation and harvesting. Consequently, they formed the Sugar Beet Growers Association to press for more favorable contracts and a secure labor force. Factory management struggled with more than just growers. They relied heavily on the Colorado and Southern Railway to bring both beets and coal to their factories. Unfortunately, shipments of both were often inefficient or poorly timed. Sugar beet factories operated during the winter, when coal was in high demand throughout the nation as its most important source of heat. Colorado possessed some of the most productive coals fields in the nation, and the Colorado and Southern Railway provided that coal to the majority of families on the Colorado Piedmont. Though the six factories possessed spur rail lines, they had to lease locomotives from Colorado and Southern to transport beets. In the winter, transporting coal generally superseded hauling beets. As a result, beet factories could not achieve efficient shipments of beets. Factories also worried about an adequate supply of water. Since all of the region’s water had been allocated by 1900, beet factories had to purchase water rights from irrigation companies. In most cases, these were some of the last water rights to be satisfied. So, in low water years, they could be left high and dry, or dependent on irrigation lawyers to take their case for more water to the courts. Grower unrest, dependency on the rails, and the unpredictable nature of water supply resulted in inefficient management.27

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27 On conflicts over water, see for example H.N. Haynes, Greeley, Colorado, to A.V. Officer, Loveland, Colorado, 9 December 1903, Loveland Archives, Loveland, Colorado, Box 2; on conflicts over coal see for example
Chester Morey recognized this as well, and he sought to change it. Believing that centralized control of the factories would result in more efficiency and greater bargaining power over workers and available resources, he convinced Havemeyer to consolidate all six factories into one company. He succeeded, and on January 13, 1905, the six factories and all of their holdings were consolidated under one management, adopting the name originally used by Charles Boettcher for his Loveland operations: The Great Western Sugar Company. The new corporation was headquartered in New Jersey, initially valued at twenty million dollars, and Havemeyer became its president.28

Over the next twenty-five years, Great Western not only consolidated its hold on existing factories, but it vastly increased the size of its Piedmont empire. By the time of Havemeyer’s death in 1907, Great Western built three more factories, in Sterling, Ft. Morgan, and Brush, enabling it to control all sugar production on the Piedmont. Owing to purchases of beet sugar factories in Michigan, Idaho, and Utah during the period from 1901-1907, Havemeyer’s sugar trust gained control of seventy percent of the entire domestic beet sugar industry at his death. By 1930, Great Western had built four additional factories on the Piedmont. Though small-scale beet sugar companies operated in two other regions of Colorado, Great Western possessed a virtual monopoly on sugar production on the Piedmont. 29

Great Western sought vertical integration as well. In this, the agricultural giant attained limited success. Transportation of beets was of paramount importance. As a raw material, sugar beets are heavy and bulky. Growers thus had to consider the time, labor, and expense necessary to transport beets to the nearest factory. If the expense did not justify the effort, then they would

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28 May, *Great Western Sugarlands*, 61-68.
contract to grow only minimal amounts of beets on their farms. Recognizing this, Charles Boettcher, Chester Morey, and the investor cohort who originally built the first factory at Loveland also signed articles of incorporation to form the Great Western Railway in 1901. They immediately acquired rights of way and built track to bring growers within easy reach of beet dumps where they could unload their cargo onto waiting train cars that would transport the beets to the nearest sugar factory. Great Western purposefully constructed the railway to increase its contracted acreage, so it built lines that meandered through the most productive Piedmont farmlands. For example, the rail line which ran between Longmont and Loveland formed a rambling semicircle in order to bring the fertile irrigated lands of the Thompson River Valley within close proximity to the Railway. However, Great Western’s dominance was not total. On some routes, Great Western could not acquire rights of way and so contracted with the local line, Colorado and Southern, to get the beets from farm to factory. In addition, both Colorado and Southern and Union Pacific lines carried finished sugar to regional and national markets. Despite this, by 1907, when Great Western had finished laying track, the majority of its Piedmont transportation needs were supplied internally.30

Great Western had limited success in controlling the three natural resources it most needed in sugar production: lime, coal, and water. Turning beets into usable sugar required slaked or burnt limestone to remove impurities from raw beet juice. In 1902, Charles Boettcher and his associates recognized the need to obtain a regular supply of limestone and executed a lease on a quarry in the foothills above Ft. Collins. Later known as the Ingleside Quarries, they quickly came under the ownership of Great Western Sugar, which then proceeded to convince...

the Colorado and Southern Railway to build a spur line to the quarries. The railway completed the line in 1906.\textsuperscript{31} Coal was necessary to operate factory machinery and Great Western’s locomotives. In this, the company saw little benefit in developing its own mines. Obtained through Colorado Fuel and Iron, coal was plentiful and relatively inexpensive.\textsuperscript{32} Water, however, was neither plentiful nor cheap, and Great Western required far more than nature could provide in any given year. In fact, according to its own 1919 figures, during beet slicing operations, which generally ran from October through January, one factory required 6.5 million gallons of water daily, equivalent to supplying the daily water needs of a city of 136,000 people.\textsuperscript{33} Moreover, since every last drop of water in the South Platte watershed had been tapped – much of it by Great Western’s growers – the company slaked its thirst by increasing supply through the building of new reservoirs and the expansion of existing ones. It also aggressively sought to purchase water rights from growers. Though it was always on the prowl for more water, Great Western never came up high and dry.\textsuperscript{34} Thus, regardless of whether the company owned all of the resources necessary for the production of sugar from beets, its vast capital resources and complete control over sugar refining on the Piedmont made it a virtual monopoly. With the capacity to produce 30 million bags of sugar each year, it was one of largest sugar companies in the world.\textsuperscript{35} Moreover, Great Western had obtained a commanding position over how natural resources, water, and labor were utilized on the Piedmont.

Great Western’s industrial dominance of Piedmont agriculture extended far beyond turning beets into sugar. In the early years of the twentieth century, while Chicago swine

\textsuperscript{31} Jessen, \textit{Railroads of Northern Colorado}, 177.
\textsuperscript{32} Charles Boettcher, Denver, to Colorado Fuel and Iron, n.d., Loveland Archives, Box 2.
\textsuperscript{34} The subject of water and industrial agriculture in the region will be addressed in depth in chapter five. For a brief treatment of Great Western and water, see May, \textit{Great Western Sugarlands}, 203-219.
\textsuperscript{35} May, \textit{Great Western Sugarlands}, 44-71.
butchers sought to use every part of the pig except the squeal, Great Western’s chemists, agronomists, and engineers devised processes and built machinery for making usable products out of every portion of the beet except the soil that clung to it. Beet pulp consisted of the fibrous materials that remained after the pressing of sliced beets. Pulp was purchased by local farmers to feed livestock during winter months. Factories turned unrefined beet sugars into molasses and chemists converted residues into food additives such as monosodium glutamate (MSG). Great Western built a factory at Johnstown specifically to re-process low-grade molasses into granulated sugar, using some of the wastes from this process to concoct a liquid protein used in animal rations. For Great Western, the sweet smell of success came from more than just sugar.

No beet byproduct received greater attention than pulp. Employed to fatten livestock during the winter months when growers were not raising beets, farmers fed pulp to livestock in liquid form. Eventually, Great Western developed the technology to dry the pulp into flakes, and later transform that pulp into pellets, enriched with a liquid protein beet byproduct. For the corporation and its growers, beet byproducts appeared to be a win-win proposition. Growers could employ the factory byproducts of their own farms to build an off-season business, and Great Western realized greater profits while tying farmers more closely to its operations. Mutual dependency defined the industrial landscape.

Timing, ecology, research, and promotion were central to this reciprocal relationship. By 1900, there was virtually no open range left on the Piedmont. The cattle industry in the region had declined sharply between 1885 and 1890 as a result of ecological damage due to

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36 Though my discussion of livestock feeding will primarily focus on cattle, it is important to note that the feeding of sheep competed on an equal-footing with cattle into the 1930s on the Piedmont, and beet byproducts were used to feed both animals. However, the development of full-time, industrial-scale feedlots in the 1930s was primarily aimed at cattle, and sheep-feeding declined precipitously beginning in that decade. Since the thrust of my research addresses the growth of industrial agriculture, sheep occupy only a minor role by comparison to cattle.
overstocking the range, plummeting market prices, and the devastating blizzards of 1885-1887, which decimated many herds. Ranchers who recovered during the 1890s emphasized crop farming during the warmer months and livestock fattening during the winter months. Cattle and sheep manure provided fertilizer to grow crops such as alfalfa, wheat, potatoes, and clover, while hay and alfalfa could be fed back to cattle. Unfortunately, this relationship of agricultural reciprocity generally lacked a significant grain that would produce efficient weight gain in cattle. The most common solution to this was to add corn to the diet of cattle, but Colorado’s growing season was not long enough to produce an abundant supply of corn locally, while importing corn from the Midwest presented a significant expense.\textsuperscript{37}

Sugar beet agriculture seemed to provide a solution to this problem. Beginning in 1890, Colorado Agricultural College (CAC) began performing experiments that utilized beet pulp and silage (the fermented tops and leaves of harvested beets) as feed, in hopes that beets might offer a suitable replacement for corn in fattening livestock. Their findings suggested that, though corn generally produced greater weight gain in these early experiments, there was ample evidence that beet pulp and beet silage, when added to rations, could fatten cattle faster than any set of locally available rations used previously.\textsuperscript{38}

Great Western wasted no time taking advantage of these and other findings, selling pulp to farmers out of its factories, performing animal-fattening experiments at its own experimental


\textsuperscript{38} David O’Brine, Colorado Agricultural Bulletin 11, (1890); Wells Cooke, Colorado Agricultural Bulletin 34, (May 1896).
farm in Longmont beginning in 1905, and promoting beet byproducts as feed while teaching farmers how to use them. Company literature emphasized that beets were “two crops in one,” since they provided a lucrative cash crop for the warmer months, and feed for stock during the winter months. Constantly aware that beets competed with corn as a feed, company agronomists argued that the locally grown beets were capable of producing 3,500 pounds of sugar and 300 pounds of meat per acre, productivity unparalleled by the Midwestern Corn Belt. Further, beet pulp and silage were economical and efficient. Into the 1930s, wet pulp was sold for only fifty cents per ton and silage could be either left to dry in the fields or placed in grower-constructed silos for use as feed throughout the winter. That silage, according to company literature, would provide even further benefit by allowing growers to reduce hay rations by half and still achieve similar results.39

It was clear that the research of CAC and Great Western, as well as company promotion had paid off. Through 1919, the local market for beet pulp was so great that demand had exceeded supply in each year. Statistics for the Longmont District during the winter of 1912-1913 alone provide further evidence. According to Through the Leaves, a Great Western publication mailed each month for free to growers, livestock in the Longmont District had consumed 600 tons of wet beet pulp daily, and over 19,000 head of cattle had been fattened on beet byproducts that season for an average of 100 days each. Moreover, those cattle produced an estimated 46.5 tons of manure, capable of fertilizing approximately 1,500 acres, and enabling county farmers to realize a gain in productivity equivalent to $7,700. Apparently, beet

byproducts and cattle byproducts possessed an elegantly symbiotic - and lucrative - relationship.\textsuperscript{40}

Widening the geographic reach of sugar beet pulp encountered one important logistical problem. In Great Western’s initial years of existence, pulp was only available in liquid form, and it was both heavy and ponderous. Delivery was costly and required more train cars than Great Western could spare during the winter when shipments of sugar and coal were prioritized. Consequently, stock feeders either had to bring their animals to pastures in factory lots to be fed, or haul the beet pulp back to their farms. Both prospects limited the reach of beet byproducts. Even company literature suggested that feeding wet beet pulp was only economical if the grower lived within a seven mile vicinity of a beet sugar factory. However, with the addition of a pulp dryer to Great Western’s Brighton facility in 1918, and then to other factories in succeeding years, the company was able to market beet pulp in dried form far beyond its immediate region, and convince local feedlot operators to include beet pulp within stock rations. After World War II, Great Western began to produce beet pulp in a pellet form, enriched with a liquid protein concentrate from beet molasses meant to enhance the fattening properties of beet pulp. By that time, the company had figured out how to wring every last ounce of edibility from the beet for human, and animal consumption.\textsuperscript{41}

No individual helps us to understand Great Western’s influence over the cattle industry on the Piedmont better than Jack Maynard, General Livestock Consultant for the company in the 1930s, 1940s, and 1950s. Like many of its other employees who worked with growers, Maynard

\textsuperscript{40} TTL 1, (December 1913): 9.

\textsuperscript{41} “Brochure Commemorating the 50th Anniversary of the Great Western Sugar Company and achievements during that period of the Animal Husbandry Section of the Colorado Experiment Station in determining the value of sugar beet by-products,” in Great Western Sugar Archives, Norlin Library, University of Colorado, Boulder (hereafter GWS Archives, CU), Accession 2, Series 5, Box 2, “General Historical Background.”
was plucked from CAC, where he was the Associate Professor in Charge of Animal Investigations at the college’s experiment station. While there, Maynard focused his efforts on experiments feeding stock various combinations of rations which included beet byproducts. In addition, he consulted regularly with agronomists from land grant colleges throughout the nation who were performing similar experiments. The success of Maynard and his students, in combination with knowledge gained from colleagues, established a template for success that Great Western could use to promote its beet byproducts, and develop its own experiments.42

When Great Western hired Maynard, the company was less interested in future livestock experiments than it was in how Maynard could marshal all of his resources to promote beet byproducts in animal feeding. It was with this in mind that Maynard wrote the seminal text on the subject, *Beets and Meat*, in 1945. In this short volume, Maynard argued that farmers who choose not to feed animals for the market were inefficient and consequently might not remain in business for long. He then went on to argue for the value of sugar beet agriculture in feeding, stating that a grower with 80 acres in beets who also fattened 100 head of cattle for 134 days during the winter season would yield not only cattle for the market, but 300 tons of manure, enough to provide most of the fertilizing needs for all of a farmer’s crops that following year. Knowing that feeders could choose from a host of products in place of beets to grow their animals, he argued that purchasing large amounts of non-local feeds rarely paid off in the long term. Maynard exclaimed that feeders in what he called the “beet belt” obtained the greatest successes when featuring beet byproducts in combination with locally grown grain and alfalfa.43

Having established the supremacy of beet byproducts in the region, Maynard employed the

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second half of *Beets and Meat* to provide feeders with tables and explanations for specific animal rations as well as a how-to-guide for building livestock shelters and feed bunks.\(^{44}\)

Maynard’s writings encapsulated Great Western Sugar’s idealized relationship between itself and its growers. From the company’s origins, it was ever-conscious that it owned almost no productive agricultural land. As a result, it was dependent on growers contracting significant portions of their land to grow sugar beets. With a substantial capital investment in Piedmont factories, rail lines and lime quarries in the region, Great Western’s financial success required not only a long-term commitment to its growers, but an obligation to support the productivity of their land. Thus, as Maynard implied in *Beets and Meat*, the company possessed a three-fold interest in livestock feeding. First, it provided financial gain to company and grower alike by providing an off-season business for growers and a market for sugar beet byproducts. Second, copious amounts of manure produced by livestock provided growers with fertilizer that supported the long-term productivity of their land and increased beet yields. Finally, and most importantly, it bound growers more closely with Great Western since they were reliant on the company’s factories not only to process their chief cash crop but to provide an essential, inexpensive, and locally produced livestock feed. Though Great Western dominated the agro-industrial landscape of the Northern Colorado Piedmont in the first third of the twentieth century, its promotion of livestock feeding helps us to see that the company’s success emanated from a mutual dependency between the company, its growers, and their land.

The nature of that dependency is rendered more powerful when we realize that fattening cattle was rarely profitable for Piedmont farmers. For most of the period from 1890 – 1920, American consumption of beef declined and, though market prices for cattle rose and fell, the

purchase price for cattle on the open market was not consistently high enough to justify heavy investment in them.\textsuperscript{45} Even with the addition of alfalfa and beet byproducts to their diets, cattle that were fattened on the Piedmont were still finished more often by farmers in the corn belt region of the Midwest. Further, despite Denver’s growing stockyards, the vast majority of cattle, even in 1930 were not slaughtered there, but in the major stockyards of Chicago, Kansas City, Omaha, and St. Louis. Then, why did Piedmont ranchers and farmers continue to raise stock for the market throughout the period?

The answer is a simple and powerful one. Cattle – and livestock in general – were part of a regional agricultural and ecological economy in which all parts were interdependent. In the absence of significant quantities of synthetic fertilizer, farmers relied intently on barnyard manure, and there was no more prodigious producer than cattle.\textsuperscript{46} Given that cattle feeders on the Piedmont provided rations of pulp that sometimes exceeded one-hundred pounds per day – in addition to their use of beet silage as a roughage - we can deduce that a large portion of this fecal fertilizer proceeding from the back-sides of bovines originated from the growing of sugar beets. But, as we have seen, these beets were made possible in part due to a crop rotation which embraced a variety of other plants, the most important being alfalfa, a forage crop that returned nitrogen to the soil and provided an excellent livestock feed. Of course, none of this was possible without irrigation. Here, too, the resource was drawn from the region. By 1900, every last drop of water from the South Platte watershed had been appropriated by users on the Piedmont. Then, from 1900-1920, Great Western Sugar and several irrigation companies built or


\textsuperscript{46} Historian Brian Donahue advances a similar argument about the interdependencies of farmers and the land for the Concord, Massachusetts region during the 1700s. In the Concord example, farmers prioritized stable, diversified farming in the face of market demands. See Brian Donahue, \textit{The Great Meadow: Farmers and the Land in Colonial Concord}, Yale Agrarian Studies (New Haven: Yale University Press, 2004).
extended a host of water storage projects to add to the region’s capacity. And, all of these interdependent pieces were given scientific and promotional boosts by the state’s agricultural college which, conveniently enough, stationed itself in the heart of the region and prioritized research which mapped onto the needs of Piedmont farmers. The human and agricultural livelihood of the Piedmont was largely sustained prior to 1930 on an agriculture that was either derived from or adapted to the region.

Great Western Sugar’s interest in conserving the health of Piedmont soils was motivated by consistent and predictable profits. Thus, it attempted to distribute some of its financial risks to its growers. Great Western did not pay its growers or farm laborers for the quantity of their work. Field laborers were paid solely from the pockets of growers based on the number of acres they thinned, cultivated, and harvested.47 Growers received remuneration only for the number of beets they harvested and, to a lesser degree, their sugar content. Prior to planting each season, beginning in 1905, Great Western issued a contract which stated how much the company would pay growers per ton of beets harvested. From 1905-1913, that figure was $5 per ton with growers receiving bonuses if the percentage of sucrose in their beets averaged more than 15%. Typically, about 10 to 15 tons of beets were expected per acre with that figure generally increasing throughout the period. After 1913, the price per ton rose steadily until the 1920s when Great Western and its growers agreed annually on contracts with lowered prices per ton in exchange for limited revenue sharing between the company and its growers. All contracts included a stipulation that every harvested beet be delivered to a factory or company beet dump.48 Though the quantity of beets harvested varied from one year to the next, once annual

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47 See chapter three for a discussion of the historical development of wages for laborers in the beet fields from 1900 to 1940.
48 May, Great Western Sugarlands, 72-114.
contracts were signed, it could make broad predictions for how much sugar it might refine in any given year. Further, the company maintained no responsibility for the crop during the growing season. Should a particular grower’s crop fail, Great Western’s factories would not have that grower’s beets to process; but it bore no burden to insure its growers against losses to either crops or land, or to pay hand laborers their wages. In such scenarios, growers and laborers experienced far greater losses than those sustained by the company.

Great Western still assumed risks related to the market and to its large capital investments in Piedmont agriculture. Once growers signed contracts to plant a given number of acres at the start of the growing season, Great Western could plan for its fall processing operations and gained information that would help it forecast the distribution of its refined sugar. By contrast, the company possessed no security against the volatility of the market. It negotiated annual contracts with growers, usually in March, for a crop that would not be harvested until October and not ready for sale as refined sugar for at least ten months. Though the company could occasionally hold back some sugar in years when the market price was low, this was not normally an option since it still had to meet its obligation to growers and investors. Moreover, should the company fail to sell its product within its regional market on the Plains and in the Midwest, it feared that sugar from elsewhere might move in permanently to fill the sugar vacuum. In addition, despite the fact that Great Western owned virtually none of the land on which beets were grown, its long-term viability depended on growers’ taking meticulous care of their land. In other agricultural industries, where the grower assumes full responsibility for raising the product to market – such as poultry farming – the parent company is not limited by geography. It can contract with farmers from multiple regions to grow or raise its product. Once stationed in the Piedmont, Great Western needed its farmers. It provided its growers not just
with seeds, but with multi-million dollar factories that were only profitable if sugar was refined near its growers. Further, since farming sugar beets in the West required that the crop be farmed in rotation with other crops, the beet sugar industry could only be successful if a critical mass of farmland were devoted to growing beets, but only cultivating them approximately two years out of every seven. Finally, as shown previously, Great Western could not so flippantly ignore the risks and responsibilities associated with land ownership since the company needed more than just beets from landowners. It needed their land.

The heavy capital investments of Great Western Sugar and the particularities of sugar beet farming effected the transfer of agricultural power from farmers to the parent company. One way to understand that transfer of power was through seeds. Prior to the introduction of sugar beets into the crop rotations of Piedmont farmers, farm practice involved saving and reusing seed from the previous year’s crop. Farmers selected seeds from the most productive plants for re-use. Some plants, such as corn, could be cross-pollinated with other varieties of corn to achieve higher yields. Since 1870, when the Union Colony organized the town of Greeley, farmers learned which plants could be most prolific and profitable under a system of irrigated farming. The saving, breeding, and planting of seeds also became a shared process through which farmers employed trial and error, the efforts of other local farmers, and eventually the experiments conducted by CAC, to refine their practices.

To comprehend the agricultural transformation effected by sugar beet seeds, it is necessary to examine the plant’s history. During the nineteenth century, the sugar beet industry developed in Napoleonic France in response to the English blockade of French ports. Seeking to eliminate reliance on imported British Sugar, Napoleon offered the equivalent of $200,000 as

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incentive to build factories which could transform beets into sugar. Through the course of the century, Germany and Austria became significant producers of sugar beets, while perfecting the cultivation of their seeds. Consequently, they were able to produce sugar at prices that middle and lower class Europeans could afford. By the late nineteenth century, sugar not only became accessible to all socioeconomic classes in Europe, but a staple food product as well.\(^{50}\)

In the United States, however, beet seeds presented obstacles to production. Prior to the 1940s, the term ‘beet seed’ was a misnomer, since each seed was composed of up to five germs, each occupying a separate compartment. When the seed within each compartment germinated, it formed part of a root ball whose shoots eventually broke the surface as five tightly compacted beet plants, each one competing for water, nutrients, sun, and growing space. Consequently, for sugar beets to grow to full maturity, they required precise hand thinning.\(^{51}\) Further, even the production of these compartmentalized seeds was complex, involving six years of selection, storage, and breeding to produce seeds that could germinate into sizeable beets containing a high sugar content. The complexity of the process and need for precision prompted Great Western Sugar’s Experiment Station Director, A.C. Maxson, to write an article aimed at growers titled, “Can the Farmer Grow His Own Beet Seed?” After initially answering the question with an emphatic, “No,” Maxson went on to argue that the sugar beet “is such a highly developed product,” it requires “certain knowledge of the principles of plant breeding and certain technique which few farmers have or have time to acquire.”\(^{52}\)

Apparently, the process was initially too complicated even for Great Western to take on, since the company regarded the production of beet seed as too time consuming and costly to


undertake commercially. Though the sugar company developed an experimental seed program, and planted small acreage on its experimental farm in Longmont, it purchased European beet seed for its growers. In 1903, Great Western spent $64,500 on seed purchases, primarily from Germany. That figure rose to $169,000 in 1910, and then $250,000 in 1914 as the sugar company expanded its operations throughout the Piedmont, providing seven different varieties of German sugar beets to its growers at a nominal mark-up of approximately 20%.\textsuperscript{53} Seed shipments were dramatically decreased in succeeding years, however, as World War I not only disrupted imports from Europe, but also ravaged the European sugar beet industry. In response, Great Western converted its experimental operations into commercial ones. Though Great Western returned to its European suppliers after World War I, it slowly expanded seed production by developing facilities in Arizona and Oregon where milder climates allowed for more consistent and controlled seed breeding and growth. By 1935, over two-thirds of sugar beets grown on the Piedmont came from domestic seeds.\textsuperscript{54}

Sold by Great Western at ten cents per pound in 1919, beet seeds did not represent a significant financial outlay for growers. Their importance was more cultural and ecological than economic. Previously, when farmers saved seed from their own crops and improved upon them through selection and breeding, they engaged in a process that tied them intimately to their land. Best farming practices included taking notes on how particular seeds performed within certain soil types, where a plant fit within a crop rotation, and the optimum times for planting, irrigating, cultivating, and harvesting. Knowledge about seeds and the practice of seed-saving and breeding implied knowledge of one’s land. Success on the Piedmont, where small acreages and market

\textsuperscript{53} Figures are taken from GWS Archives, CU, Accession 1, Series I, Boxes 17 and 18, “Annual Statistics Recap.”

agriculture were the norm also necessitated that farmers consult each other regarding successes and failures with particular seeds. Though each piece of land in the region possessed its own peculiarities, farmers shared the same climate, similar soil types, and irrigation needs. In relinquishing control over seeds to Great Western, farmers also surrendered a degree of knowledge and control over their land.

Labor provides another window through which to view how beet seeds reduced farmers’ autonomy over their land. Because sugar beets germinated and burst the soil in tight clumps, growers had to invest significant money toward the labor necessary to thin their beets so that only the healthiest plants were allowed to grow unobstructed by weaker ones. The entire sugar beet industry depended on precise thinning within a narrow window of time, usually during late May and early June. Failure to thin within that time frame resulted in slowed growth, and reduced sugar content. But beet thinning was a Herculean task. An intensively farmed acre of beets consisted of rows that, if stretched out in linear fashion, would lengthen to five miles. The typical beet farmer on the Piedmont during the first half of the twentieth century possessed between 100 and 160 acres. With an effective crop rotation, beets were planted on one-third of a farmer’s cultivable land. Thus, during a given season, forty to fifty acres were planted in beets, requiring a typical grower to thin over 200 miles of these sugar-laden vegetables. Given the immensity of the task, and the physical demands of stooping to separate beet plants during the heat of the day, few growers performed their own thinning. They hired extra-local laborers, or they rented part of their land out to tenants who either performed the work themselves, or employed additional labor to do so. Once the beets were thinned, some of the work of cultivation could be completed by a machine, but much of it had to be done by hand in a process referred to as second hoeing. Frequently, a third hoeing was required as well. Harvesting the
beets was even more physically intense. Though growers generally used horse- and tractor-drawn beet pullers to loosen the dirt around the beets, the deep taproots of the plants and the need to protect the sugar content inside each plant necessitated hand labor.55

That labor commonly took the form of large families brought to the Piedmont specifically to thin, cultivate, and harvest beets. Until 1920, the majority of those families were Germans who had recently immigrated to the Great Plains and the Midwest by way of Russia. Immigration of these German-Russians was cutoff during the upheaval of World War I, and Great Western then ramped up its recruitment of both Mexican nationals and Mexican-Americans and their families to do the hand labor. Generally, the male head of each household signed a contract with a grower to thin, cultivate, and harvest all of the sugar beets on an agreed upon number of acres. The contracted acreage varied widely from fewer than five acres to over twenty. Hand laborers based the number of acres they could handle on the size of their family, since Great Western and its growers assumed that all able-bodied family members would participate in tending the beets.56

It would be easy to miss that this industrial labor force represented a significant power transfer from farmers to corporation and a growing disconnect between the grower and his land. Since most beet laborers did not live on the Piedmont, they had to be located and imported to the region - a task beyond the scope of growers. Growers gladly relinquished that task to the dozens of Great Western labor agents who were deployed primarily in the Midwest and Southwest to find workers.57 While some growers were able to attract the same families year after year, others struggled from one year to the next to find satisfactory workers available at the precise time that

55 Anderson, Geography of the Sugar Beet Industry, 16-42.
labor was needed. Moreover, the same processes that shifted responsibility for finding agricultural labor to the corporation also shifted the responsibility of caring for beet land to the migrant laborer. While growers still manured, plowed, harrowed, irrigated, and cultivated their beet acreage, hand laborers spent far more time with that land during the growing season. By some estimates, these laborers accounted for fifty-five percent of the costs of raising a crop.\(^{58}\)

Working primarily on their hands and knees, they developed eyes for immediately recognizing which beet plants to thin and which to leave. They were the most likely to notice any pests and diseases which afflicted the plants or the soil, or if plants were wilting and required irrigation. The choice to grow beets delimited the relationship between farmers and their land as they handed control over seeds and labor to the sugar company, while placing care for their crop into the hands of migrant laborers. This was part of the larger process that made growers out of farmers and transformed intensive agriculture to industrial agriculture.

Another way to understand this transfer of power is through the lens of specialization. Like assembling car parts in a factory, industrial agriculture called for specialized roles for each of its actors. We’ve viewed this division of labor on beet acreage where labor was divided between growers and laborers, and in the beet factories where the vegetable was transformed into sugar and beet byproducts by chemists, wage laborers, and complex machinery. But the intricacies of producing sugar were not limited to the factories. They were found in the fields as well. Consequently, Great Western employed a host of trained agricultural scientists called fieldmen to guide growers in beet production. Among them, the fieldmen maintained constant relationships with growers. They distributed seeds; supervised the raising of beets; helped to

maintain farm machinery; distributed migrant laborers to the growers; mediated in conflicts between growers and the company; made sure contracts for beet acreage were signed and distributed; provided advice on the use of insecticides, fertilizers and chemicals; conducted farm demonstrations; and acted as consultants to growers on a variety of matters. As of 1919, Great Western employed seventy such individuals, primarily plucked from agricultural colleges such as CAC.\(^59\) And yet, while fieldmen disseminated knowledge about beet culture, they rarely generated it. For this purpose, Great Western established research stations at Longmont and Ft. Collins where the company’s agronomists, chemists, botanists, soil scientists, and entomologists conducted practical investigations aimed at enhancing yields and producing beets more laden with sugar. These agricultural stations served six purposes: beet breeding, developing better farm practices, pest control, developing more efficient irrigation, disease control, and studying the economics of growing beets.\(^60\)

It was not possible to disseminate the latest sugar beet research solely through the company’s fieldmen. Consequently, Great Western began publishing Through the Leaves in 1913. The monthly publication was mailed free of charge to the company’s growers, and offered for ten cents per issue to other interested parties. Though topics in Through the Leaves ranged widely, they revolved around producing more beets and raising the sugar content within each one. The majority of articles reminded growers of established best farming practices, informed them of how to apply the latest sugar beet research, and provided updates regarding issues of concern such as how many laborers might be available in a given year or how changes in the tariff might impact the price of sugar. In short, Through the Leaves’ functioned both as a

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paternalistic how-to manual for beet production and as company propaganda aimed at its growers.

As the corporate organization of Great Western suggests, the move from intensive to industrial agriculture and the development of a specialized division of labor were deeply entangled processes. On the eve of the Great Depression, when Great Western held the leading position over sugar beet production in the United States, and Piedmont farmers had oriented much of their irrigated farmland around this lucrative cash crop, the beet grower had become one component within a complex machinery of sugar manufacturing. While farmers retained the right to grow crops of their own choosing - and there were many who refused to cultivate sugar beets – the majority chose to grow beets for Great Western Sugar, as sugar beets were the most lucrative crop in the region. Doing so required migrant workers and reliance on company labor agents to locate them. Contracts mandated that all beets be harvested and delivered to Great Western’s factories and beet dumps where experts and laborers transformed vegetables into sugar in a highly specialized process. Successful farming implied a reliance on expert knowledge not obtainable without the help of company fieldmen and publications. Agriculture on the Piedmont had become a highly specialized and technical process and managing the land required an intricate division of labor.

If an outside observer had to look with a keen eye to view how sugar beet growers relinquished power over the Piedmont landscape to Great Western Sugar, it took little effort to see that the production, marketing, and consumption of sugar itself was beyond their purview from the start. As a commodity, sugar was produced and sold in markets that spanned the globe, and there were no physical or chemical differences between the beet sugar processed in Colorado and the sugar from cane that was harvested in tropical regions. And even though in most years,
all Piedmont sugar was sold domestically, Great Western strove for a large market share against
the much greater productive capacities of cane growing regions such as India, Cuba, and the
Philippines, and against the sugar beet growers of Europe. Moreover, since the costs of
manufacturing domestic beet sugar were consistently in excess of the costs of an identical bag of
international cane or beet sugar, U.S. growers relied on a system of tariffs and quotas to protect
the viability of their crop. Because intimate knowledge of the worldwide sugar market was
beyond the scope of most growers, they depended on their corporate employer to package such
complexities for their consumption. And, with even less influence over the sugar market than
knowledge about it, growers relied on Great Western to lobby on their behalf. Though sugar
beets dominated the Piedmont landscape, Piedmont growers were bit players on the world stage.
They needed a corporate sponsor.

The origin and growth of the domestic sugar beet industry were made possible by an
explosion in sugar production and consumption in the nineteenth and early twentieth centuries.
Between 1800 and 1890, worldwide production of sugar went from 245,000 thousand tons to six
million tons. How was this possible? During the nineteenth century, industrializing nations such
as Great Britain and the United States developed cane sugar industries in their colonies and
protectorates in tropical and subtropical regions of the world including India, Cuba, Hawaii, and
the Philippines, as well as in Louisiana. At the same time, Continental European nations led by
France, Germany, and Russia developed their own domestic beet sugar production, in part to
maintain independence from England’s imperial possessions. As the quantity of sugar
skyrocketed, manufacturing costs plummeted, propelled by factory innovations and efficiencies
in cultivation and harvesting. These factors made sugar accessible to all socioeconomic classes.
Moreover, sugar provided quick energy for the long hours of workers during the Industrial
Revolution, and cheap calories for their impoverished families. Further, as urban families consumed more manufactured products, sugar became a universal sweetener in a host of industrial products such as jams, cakes, candies, and breads, and an indispensable additive to drinks such as coffee and tea. By 1900, British consumers, who occupied the leading edge in this sweetness revolution, were ingesting fourteen percent of their total caloric intake from sugar.\textsuperscript{61}

Though American consumers lagged behind their British counterparts, they quickly gained ground as productive capacities and latent industrialization led to exponential increases in consumption. Between 1895 and 1900, the United States added to its homegrown cane sugar industry in Louisiana. Imperial wars and insurrection enabled American sugar interests to gain control and expand cane sugar production in Hawaii, Cuba, and the Philippines. At the same time a growing urban population followed the example of British consumers. By 1922, the typical American was consuming one hundred pounds of sugar per year, a tenfold increase over the previous hundred years.\textsuperscript{62}

These changes in consumption prefigured the transformation of the Piedmont landscape. Pre-1900 attempts by regional boosters and CAC to develop a sugar beet industry were localized versions of worldwide attempts to take economic advantage of a booming industry. But, as we have seen, the industry required capital beyond the scope of farmers and small colleges. So, the next logical step in the move to exploit the sugar boom was taken by investors, and finally by the sugar trust. That they were successful is borne out by statistics. Between 1900 and 1922 the sugar produced from beets in the United States increased from fifty thousand tons to one million

\textsuperscript{61} Mintz, \textit{Sweetness and Power}, 19-150.
\textsuperscript{62} “Sugar,” 150-231.
tons.\textsuperscript{63} As the leading producers of sugar beets in the country, growers on the Piedmont accounted for a large share of that increase.

The same explosions in production and consumption that made the Piedmont sugar industry possible also separated the process of production from the process of consumption. Sugar beets demonstrated this process more tangibly than any other crop that could have been grown on the Piedmont. As a root crop, beets largely replaced other root crops, such as potatoes, in a farmer’s rotation. And, though potatoes grown in the region were largely sold on the market rather than consumed on the farms where they were grown, they were edible, and generally consumed in the same form from which they emerged from the earth. Strictly speaking, sugar beets can be consumed in the same way, but this rarely occurred since they were genetically bred for their sucrose content and growers were contractually obliged to deliver their entire crop to a Great Western factory or beet dump. Hand laborers – only indirectly connected to Great Western through the grower – did not consume sugar beets since they were inedible apart from cooking and their sugar could not be extracted except through factory processes. Even sugar cane workers occasionally gained sustenance from cultivation and harvesting, since cane sugar could be extracted by sucking the juices from the ripening cane plant.\textsuperscript{64} No, sugar beets were the ultimate industrial plant. The production of sugar beets and the consumption of sugar were severed at the moment beets were delivered to a Great Western factory.

Dissecting the divide between producer and consumer requires understanding timing and geography as well. Historian William Cronon has argued that the products of the land – whether they be natural resources, animals, or crops – lose their connections with their landscape of origin and with those who manage and harvest them as they are transported to cities to be

\textsuperscript{63} Ibid.

\textsuperscript{64} Mintz, \textit{Sweetness and Power}, 151-186.
processed. Or, as with crops such as wheat and grain, they become abstractions when they are sorted, graded, and mixed with the products of other farmers. Though the same processes were at work in sugar beet agriculture, the product became an abstraction before it ever left the Piedmont since beet sugar was generally processed at a factory within a fifteen mile radius of the harvest. The nature of the vegetable seemed to ordain the process. Unlike other grains and vegetables such as wheat or corn grown in the larger Great Plains region, beets were too heavy to be economically transported for long distances in their harvested state. Moreover, they lost value if they sat for more than a few weeks at a time, even if placed in silos, since sugar content waned quickly. Consequently, beets were only valuable if they became sugar fast! The segregated processes of production and consumption, as well as the very nature of the sugar beet, conspired to minimize the power of growers over their crop while rendering them anonymous soon after they were harvested.

While processing sugar beets made growers faceless and placeless during sugar production, Great Western sought to render growers and their land visible for the purpose of marketing their sugar in the Midwest, Great Plains, and throughout the West. Throughout the 1920s and into the 1930s, GWS published ads and articles in *Through the Leaves* telling growers that they should purchase only sugar from Great Western and further, they should convince their friends and relatives throughout the region to do the same. Great Western never intended to export its product since it could not hope to compete with cheaply produced foreign cane sugar in other markets. In addition, the company paid greater costs when their product was freighted to seaboard towns such as New York or San Francisco and then shipped to other locales from there.

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Consequently, Great Western realized its highest profits when it unloaded its product nearer to the sources of production. They believed growers could be noble foot soldiers in this endeavor.

Corporate strategy mixed altruism, financial incentives, company loyalty, and an appeal to membership in the larger farming community to accomplish its goals. In explaining the strategy to promote regional consumption, the editors of Through the Leaves explained how reduced freight rates would lower consumer prices. This was especially important since cane producers throughout the world were ramping up production during the 1920s and were seeking a larger share of markets in the United States. According to the authors, if they succeeded, the economies of entire regions dependent on sugar beets – the Northern Colorado Piedmont being paramount among them - would decline. Moreover, a failing industry would result in a reduction of consumer choice which would in turn allow cane producers to increase their prices in the absence of competition. Finally, the authors pointed out that local and regional purchases of Great Western’s sugar resulted in reduced costs of production, enabling the company to pay its growers more handsomely.\(^66\)

Other ads and articles played on a shared affinity for all farmers in the region. One ad pointedly asked, “Does the Sugar You Use Help an American Farmer?,” and then went on to state that there were many consumers living between the Mississippi River and the Rocky Mountains who were still purchasing cane sugar. The ad went on to argue that beet sugar would take less money out of the wallets of consumers while placing more money in the hands of farmers.\(^67\) Other ads used the same logic, but targeted relatives and farmers in the corn belt of Iowa, stating that Iowa corn farmers were not competitors with beet farmers in Colorado, and

\(^{66}\) “Editor’s Notes,” *TTL* 12, (May 1924): 223-224; Sugar beet grower contracts through most of the 1920s included a profit-sharing arrangement whereby growers received a percentage of the profits made by the corporation.

\(^{67}\) *TTL* 12, (April 1924): 208.
they could only stand to benefit one another through purchasing each other’s products. Other ads attempted to personalize that relationship between corn and beet farmers. In one such promotion, Great Western growers were told to contact “Cousin Bob in Iowa,” and to tell him that he should not only purchase Great Western sugar, but request that all retailers carry it.68

Part of Great Western’s regional consumption campaign involved combating notions that beet sugar was of a lower quality than the cane variety. Its ads consistently stated that beet and cane sugar “are identical in every sense of the word,…have the same chemical and physical properties,” and “have the same food or nutritive value.”69 To add scientific weight to such statements, Great Western wrote a letter to the Bureau of Chemistry at the USDA, asking for a statement about the chemical merits of beet sugar. In terms that were both explanatory and scientific, Acting Bureau Chief, C.A. Brown concluded that, “there should obviously not be prejudice on the part of the consumer against either the product of the sugar cane or the sugar beet.” Great Western reprinted the letter in the April 1924 edition of Through the Leaves.70

In 1930, The Mountain States Beet Growers Association joined Great Western in its campaign to market beet sugar in the Plains and the Midwest. Originating in 1918, this independent association functioned both as the primary bargaining instrument for Great Western’s growers and as a marketer of sugar beets. In 1930, it launched a drive to convince people in the rural Midwest, Great Plains, and Mountain West to request Great Western sugar at their local retailers. In addition to employing Great Western publications, the Beet Growers Association used personal contacts, direct mail, newspapers, and radio advertisements. Further, they employed two representatives, Robert Schaefer of Fort Morgan and F.A. Hershey of

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69 “Beet Sugar,” The Iowa Homestead (Des Moines), 5 June 1924, reprinted in TTL 12, (June 1924): 385.
Denver, to travel throughout the Midwest to meet with farmers. While touting much the same agenda as Great Western, the Association also argued that a thriving beet sugar industry benefited corn and wheat farmers in the Midwest since acreage occupied in cultivating sugar beets would otherwise likely be planted in corn and wheat. In other words, a healthy sugar beet industry minimized competition.71

The campaigns of Great Western and the Mountain States Beet Growers Association suggest that William Cronon’s argument stops short of completion. Though there is no question that the process of making consumer products out of sugar beets turned growers, their farms, and sugar itself into commodities, strategies for marketing beet sugar rendered form to that abstraction. The corporation and the Beet Growers Association asked farmers and consumers to see the sugar they consumed as part of an interconnected network that linked sugar beet growers in Colorado to corn farmers in Iowa. To convince regional consumers to buy Great Western sugar, the company asked consumers to view cane sugar and its workers from Cuba and the Philippines as foreign abstractions while purchasing beet sugar supported real people whose livelihoods resembled their own. Local and regional consumption of Great Western sugar was aided by the perception that consumers could envision the face of the Middle-American farmer on every bag purchased.

Even though Great Western’s promotional schemes appear to have returned some agency back to the individual sugar beet grower, we must understand that it was a power bounded by the dictates of corporate paternalism. Always aware of the financial bottom line, Great Western’s efforts sprang from concerns about the growth of imported sugar and the re-establishment of the sugar beet industry in Europe during the 1920s. To compete, Great Western needed to create a

hedge of economic protection around the regional market. By using the corporate magazine to promote local consumption and help farmers see their mutual dependency, they were simply distilling the complex machinations of a faceless international sugar market into digestible form. It is further instructive to note that the Mountain States Beet Growers Association’s strategy for promoting regional consumption, which it launched six years after Great Western’s own scheme, largely mirrored that of the corporation, suggesting not autonomous grower advocacy, but the success of paternal policy. In this case, industrial agriculture employed the services of individual farmers beyond their fields; but like a well-meaning parent, the corporation prescribed its own formula for employee success.

Though farmers were instructed in how to impact regional markets, it was national and international markets that dominated the corporate concerns of Great Western Sugar. The company owed its existence and growth in part to an insulated market for domestic sugar that was made possible by a protectionist culture and high tariffs from the 1890s to the 1930s. These tariffs kept cheap imported cane sugar from flooding the American market. In July of 1897, Congress passed, and President William McKinley signed, the Dingley Tariff which created tariff walls on commercial grade imported sugar at a rate of 1.685 cents per pound. Supporters argued that the tariff on sugar and many other imports was justified by the need to protect and encourage fledgling industries in the United States. If the growth of beet sugar factories and the overall production of sugar are any indication, then the tariff succeeded in its aims. Between 1892 and 1902, the number of factories increased from six to forty-one, while total tonnage of sugar refined in those factories skyrocketed from thirteen thousand tons, to over two million tons.72 It is also no coincidence that boosters in Piedmont towns as well as at CAC increasingly

clamored for and finally received the majority of their factories in the ten years that followed the Dingley Tariff.\textsuperscript{73}

The impact of tariffs on sugar prices held the greatest possibility of destroying the sugar beet industry. After the conclusion of the Spanish-American War, the federal government encouraged the growth of raw cane sugar in Cuba and the Philippines and the refining of that cane in the United States. The Philippines, a protectorate of the U.S., and Cuba, a newly independent nation watched over closely by the U.S., received reductions of 25\% and 20\% respectively on their sugar duties. As cane sugar imports grew alongside the domestic beet sugar industry, sugar refiners and free trade advocates attempted and failed to allow imports from the Philippines to enter duty-free. But, in 1913, their efforts paid off when Woodrow Wilson signed the Underwood Tariff. This brought the tariff on sugar down to 1.25 cents per pound and would progressively lower that rate annually until 1916, when foreign sugar could enter duty-free. Beet sugar executives howled that this would destroy their entire industry.\textsuperscript{74}

Their efforts were rewarded through legislation and conflict. Midterm elections in 1914 resulted in a Congress more amenable to protectionism, and provisions of the Underwood Tariff that reduced the sugar tariff below 1.25 cents per pound were repealed. That same year, World War I erupted in Europe. The conflict decimated Europe’s sugar beet industry, an industry that had accounted for nearly half of the world’s annual sugar production. The conflict also reduced competition from foreign cane sugar as the United States steered Cuban sugar to Great Britain, a nation which had consumed some of its sugar from beets grown in Germany, Austria-Hungary, and France prior to the war. When America was drawn into the conflagration in 1917, the sugar

\textsuperscript{73} Examples of these promotions include Colorado Agricultural Bulletins 43 (1898), and 51 (1899), as well as \textit{Ranch and Range}, 3, no. 12 (1902): 5-33. By 1907, Great Western Sugar either acquired or built beet sugar factories at Loveland, Longmont, Greeley, Ft. Collins, Eaton, Sterling, Ft. Morgan, and Brush.

\textsuperscript{74} May, \textit{Great Western Sugarlands}, 220-237.
beet industry and the Federal Food Administration agreed on price ceilings that, although they did not allow the industry to rake in profits, still guaranteed steady returns. At the same time, the USDA encouraged the industry to expand production to fill the gaps created by the war.75

The war’s conclusion again demonstrated the impact of the tariff for beet sugar manufacturers. With the end of price controls, Great Western’s encouraged its growers to sign contracts for record-breaking beet acreage. With consumption no longer restrained by war, 1920 promised to be a year of soaring profits for Great Western and its growers alike. Grower incentive was enhanced by new contracts that lowered their beet payments based on tonnage harvested in exchange for a profit-sharing arrangement whereby they divided shares of Great Western’s revenue. It turned out that projected demand in the United States was inflated. Under generally inflationary conditions, the price of raw sugar climbed to 22.5 cents per pound in May 1920. Rushing to take advantage of the situation, Cuba sought to unload its entire recently harvested crop on the United States at the same time that Piedmont farmers were just beginning to thin their record beet acreage. The result was that in December of 1920, when Colorado refineries were operating at full capacity, sugar prices had dropped to 3.625 cents per pound. While sugar executives opined (again), about the death of the industry, they also employed lobbyists to raise tariff walls to new heights. In 1922, they succeeded with the passage of the Fordney-McCumber Tariff which raised the tariff on imported sugar to two cents per pound. Two years later, after prices had stabilized, Great Western recorded well over $12 million in profits, its highest figure to date. Though sugar prices remained relatively low through the 1920s, the advantage gained by the McCumber Tariff, propelled another boom in the beet fields

of Northern Colorado. Great Western spent a great deal of energy during the period to retain and expand its tariff advantage.76

Some of that energy was expended on explaining the complexities of trade and the tariff to its growers. The starting point for that explanation largely regarded Europe, Cuba, and the Philippines. During World War I, Cuba’s sugar production expanded rapidly to meet the needs of Europe. After the war, Europe’s beet sugar industry slowly recovered to the point where it was producing half of its 1913 totals. Though no longer exporting much of its refined sugar, neither did the continent import much Cuban sugar either. Cuba’s greatest hope was to gain a greater share of the American market. Though it still paid only 80% of the full tariff, its largely American investors protested that such protectionism amounted to profiteering from the American consumer. In 1924, amidst record profits for the beet sugar industry, they possessed a valid argument.

In response to the question, “Should the Sugar Tariff Be Lowered?,” Great Western told growers in 1924 that the tariff was not only essential but protected far more than their survival. Should the beet sugar industry suffer, they argued, it would not only hurt growers and Great Western but all of the crops that relied on beets. As the key cash crop in their field rotation, growers had conditioned their land around its production. There was no other crop, they argued, that could provide the same combination of soil health and financial gain. In perhaps a bit of hyperbole, they suggested that if sugar beets failed, then so would the agriculture of the entire region. They added that the Piedmont’s economy also revolved around beets, including bankers, irrigation companies, railroads, and, of course, growers and laborers. The article concluded that lowering the tariff on sugar was an attack on American agriculture. To suggest the impact that

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Cuban sugar might have on the beet industry, *Through the Leaves* also printed calculations on worldwide sugar production in 1924. In the seemingly plain language of statistics, they pointed out that Cuba was responsible for almost twenty percent of the world’s sugar, while the entire sugar beet industry of the United States only supplied four percent of the product. By reading the company publication, the typical Piedmont beet grower would be led to believe that a high tariff provided a sea wall to protect the American farmer from the hurricane-like surge of Cuban sugar.\(^77\)

As that surge grew throughout the 1920s, Great Western increased the quantity and boldness of its pro-tariff stance. They argued that the tariff protected what American religious and social commentator John Ryan had called a “living wage,” and others in the 1920s were referring to as an American standard of living. According to this logic, sugar beets were more expensive to grow and process because farmers and laborers in the industry were paid wages sufficient to provide not only for subsistence needs but modest amounts of property ownership and consumption. Great Western Sugar, as well as the Mountain States Beet Growers Association argued that sugar cane could be produced cheaply due to the low wages and substandard working conditions of its laborers. Thus, a protective tariff provided a bulwark against the inhumanity of the cane sugar industry at the same time that it defended an American standard of living.\(^78\)

While it was certainly true that workers in the tropical sugar cane fields of Cuba, the Philippines, and Hawaii were paid a pittance for their labor, it was disingenuous to compare those wages to the income of growers in sugar beet regions such as the Piedmont. The human

\(^{77}\) “Should the Tariff be Lowered?,” *TTL* 12, (September, 1924): 472-474; “World’s Beet and Cane Sugar Production,” *TTL* 12, (December 1924): 475.

analogue for tropical cane workers was hand laborers in the sugar beet fields. Using that comparison, Great Western’s argument for an American standard of living fell flat since the laborers who completed the majority of work in the beet fields had to enlist the labors of their entire families to earn wages sufficient to support those families, while Great Western’s growers typically provided dilapidated housing for those families. Planting, harvesting, and processing cane sugar required fewer human-hours of labor to manufacture the same product. But Great Western’s comparison did possess some truth. In most of the sugar-cane-growing world, the corporation owned the land on which the cane was grown and therefore did not need to negotiate with growers. On the Piedmont, Great Western lacked such autonomy since it had to contract with growers who were capable of selecting alternate crops and, prior to the advent of the beet sugar industry, had some success in doing so. Thus, it was fair to suggest that the beet sugar industry provided a living wage for growers; but that statement deliberately obscured more than it revealed.

The beet sugar industry’s push for even greater tariff protections combined with the initial onset of the Great Depression in 1930 to produce the highest tariff on sugar in American history when Congress passed the Hawley-Smoot Tariff in 1930. As the worldwide price of sugar declined, tariffs rose to two cents on Cuban sugar, and two-and-one-half cents for most of the rest of the world. Perhaps sensing that its attacks on Cuban cane no longer resonated, Great Western turned its invectives to the Philippine sugar industry. In a nod to free trade and America’s status as protector of these Pacific islands, the Underwood Tariff of 1913 had allowed

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80 On some of the labor relations in both the sugar cane and beet fields see Sidney Wilfred Mintz, *Sweetness and Power: The Place of Sugar in Modern History* (New York, N.Y: Viking, 1985), 74–186.
Philippines’ sugar to enter the United States duty free. Though the islands produced only about ten percent of that harvested by Cuba in the mid-1920s, they more than doubled their production between 1925 and 1932, and all but a fraction of it was being sold on the U.S. market.

Regarding the Philippines, authors in Through the Leaves employed many of the same argument for limiting foreign sugar, with one important addition. Great Western argued that duty-free Philippines sugar was a byproduct of its status as a protectorate of the United States. If those islands were finally granted their independence, then their exports could be subject to economic restrictions just as those of any other nation.81 This was an especially poignant argument in the early 1930s when the Great Depression constricted the beet sugar industry, and it merited an article by W.D. Lippitt, Great Western Sugar General Manager and President of the U.S. Sugar Beet Association. Lippitt pointed out that stagnant consumption of sugar and the need for greater efficiency in the industry had resulted in shutting down 38 out of the United States’ 103 sugar beet factories in 1931. As American growers and workers suffered, Lippitt argued, sugar from the Philippines remained duty-free. Moreover, the “tropical standards of living and wages” present in the Philippine sugar industry make it “impossible for the American sugar farmer to compete with cheap Philippine labor.” Later articles even went so far as to suggest that the protected status of Philippine sugar effectively shielded that nation from the Depression, and forced American producers to bear its worst blows.82 It was no coincidence that, when Congress approved Philippine independence in the Tydings-McDuffie Act of 1934,

81 Paul Kramer argues that the push for Filipino independence in the United States during the Great Depression was motivated both by economic concerns over duty free imports as well as racially motivated concerns over Filipino immigration. See Paul A. Kramer, The Blood of Government: Race, Empire, the United States, & the Philippines (Chapel Hill: University of North Carolina Press, 2006), 347–432.
less than two months would elapse before it also placed strict quotas on the importation of sugar from that nation.\textsuperscript{83}

In becoming growers for Great Western Sugar, farmers on the Piedmont tethered themselves to worldwide sugar production and consumption in ways they could neither manipulate nor manage. Though growers retained control over how many acres to plant in sugar beets, successful cultivation of that crop could not guarantee long-term success. International conflicts, sugar cane production in the Caribbean and the Pacific, and the politics of the tariff were all volatile issues that played on growers’ fortunes. In a world where politics, markets, and consumption could not be disentangled from crops, soil, and water, Great Western played the role of industrial parent, promoting beet sugar in local, national, and international marketplaces, then packaging information about those marketplaces for its growers in an abridged and filtered form.

While farmers relinquished some of their autonomy in becoming growers for Great Western, there was much for them to gain. Profit and security topped the list. Prior to World War I, market prices for sugar steadily increased.\textsuperscript{84} Though Piedmont growers often complained about their share of the profits, they had hitched their wagons to a successful and growing industry. Further, the nature of annual contracts guaranteed them a price for the tonnage they produced. While the size of their harvest varied from one year to the next, they did not have to be concerned that the market value for sugar might drop in October since they had signed contracts with the sugar company six months previous. In fact, there was a certain simplicity in

\textsuperscript{83} The Jones-Costigan Act, also known as the Sugar Act of 1934, was an amendment to the Agricultural Adjustment Act, and it placed quotas on all of the sugar imported into the United States and provided subsidies to domestic growers. This subject is covered in greater detail in Chapter 3, which addresses beet labor.

contracting to turn all of their harvested beets over to Great Western. It meant that growers did not have to deal with middlemen or be concerned with railroad rates. Once the harvested beets were delivered to the factory or beet dump, their responsibility was fulfilled. There was even some desirability in hiring wage laborers to thin, cultivate, and harvest their beets. Those tasks were the most labor intensive of managing a farm. If growers could hire others to complete those tasks while still making a modest profit, it enabled them to work at less energy intensive tasks, or even take advantage of the growing variety of leisure opportunities available during the first half of the twentieth century. It is not difficult to imagine Piedmont farmers viewing the same factors that reduced their autonomy as essential components in an attempt to move into the middle class.

In the thirty years between 1900 and 1930, the agricultural landscape of the Piedmont had radically changed from what it had been in the previous thirty years. From 1870, when the Union Colony was established, until 1901, when factory processing of sugar beets began in Loveland, farmers generally farmed intensively on small acreage. Their largest investment was often in the irrigation necessary to produce crops for the market. Though acreages varied and farmers occasionally cooperated to market their crops, the hand of corporate agriculture was nowhere to be seen. Within six years, between 1901 and 1907, Great Western Sugar built or purchased seven beet sugar factories, and the majority of farmers within fifteen miles of one of these factories were growing sugar beets for the nation’s sugar trust, headquartered in New Jersey. Expansion over the next two decades brought virtually every farmer on the Piedmont to within a reasonable distance of a Great Western factory. Moreover, GWS leveraged its growing stature and capital to build or purchase rails lines, water rights, and quarries in order to commandeer all of the resources needed to turn an obscure vegetable into refined sugar.
Though the majority of farmers still grew a diverse set of crops, their crop rotation revolved around sugar beets, the region’s new chief cash crop.

By becoming growers for Great Western, farmers both tied themselves to a corporate parent and relinquished many of their other functions to that corporation. Deficient in labor they turned to Great Western to provide extra-local workers. Needing know-how for this new crop, they embraced the company’s agronomists, chemists, fieldmen, and its grower-oriented magazine, *Through the Leaves*, for advice and direction. Without the ability to know and order the market for sugar, they relied on Great Western to provide updates on sugar consumption, prices, international competition, and legislation related to their mainstay crop. Needing feed for their livestock, growers came to rely on beet pulp, flakes, and pellets – processed in Great Western factories - to fatten their animals for market. Lacking the scientific expertise to produce their own seeds, growers acquired them from Great Western through its suppliers in Europe, and eventually through the company’s own seed farms. Though farmers had the choice to become growers for Great Western, once that decision was made – and most farmers on the Piedmont grew beets for GWS – they relinquished much of their authority over their crops, their labor, and their land. Growers became part of the larger division of labor, specializing in the care of their land, planting, irrigation, some cultivation, and getting harvested beets to Great Western. The remainder of the process, which converted productive land into sugar, was out of their hands. That transfer of power alongside the development of a specialized division of labor is at the heart of industrial agriculture.

One piece of that specialized industrial puzzle requires closer examination. The vast majority of labor required to move sugar beets from seed to factory was provided by extra-local workers and their families who emerged from the shadows from May through October to thin,
cultivate and harvest beets. Occupying largely invisible positions in Piedmont society, they nonetheless provided the cheap labor that made sugar from beets economically viable. Moreover, industrial agriculture came to be defined on the Piedmont by its marginalized workforce.
Chapter 3: The Laboring of Industrial Agriculture

Here is set out the misery brought to human beings and the destruction wrought on the soil where there is no allowance for humanity or respect for Nature.¹

The Earl of Portsmouth

In 1955, Great Western Sugar celebrated its Golden Anniversary. Initially coordinated by company executive, Elvon Howe, Great Western assembled a diverse publicity campaign in order to highlight its pivotal position in the social and economic life of the Colorado Piedmont. It employed speakers to appear at county fairs, 4-H meetings, and on radio shows. It enlisted the aid of district managers to compile factory histories and to promote awards programs for exemplary employees. Concerned about losing acreage in the region to corn, Great Western meticulously cited the results of internal and university studies that cited the economic and ecological value of sugar beets to growers. The company also employed newspapers, magazines, films, and its own internal publications such as Through the Leaves to provide inspirational histories of the company’s preceding fifty years while spinning glowing predictions for its future. Great Western’s anniversary offered a glimpse into pieces of its past it hoped to celebrate, as well as those it would rather forget.²

Though Great Western’s anniversary campaign had many facets, no theme emerged more prominently than progress. Flushed with pride over recent successes in mechanizing its farm

² E.L. Howe, “Survey of Promotional Possibilities in the Great Western Sugar Company’s Fiftieth Anniversary Year,” 21 June 1954, Great Western Sugar Archives, Norlin Library, University of Colorado, Boulder (hereafter GWS Archives, CU) Accession 2, Series V, Box 2, General Historical Background: Publications, Pamphlets etc..
operations, company executives were careful to point out that its own advances in seed
technology and specialized machinery had virtually eliminated the need for hand labor, and that
the individual farmer could expect further advances in technological efficiency in the future.
Those consuming Great Western’s ads, articles, and films were treated to pictures and
descriptions of farmers re-enacting scenes of frontier individualism from the saddles of tractors
with an inviting Rocky Mountain panorama in the background. 3 To craft this visual feast within
the narrative of progress, Great Western harnessed the services of Thomas Ferril, Director of
Publicity. By the 1950s, Ferril had established a reputation as one of the finer poets of the
American West, eventually being selected as Colorado’s Poet Laureate in 1979. As a lifelong
Westerner whose verses celebrated progress, and possessing twenty-five years of advertising
experience, Ferril was the ideal choice to write and film what would be called “The Great
Western Story.” 4

The narrative of progress was evident throughout the film. The opening scenes moved
quickly through familiar stories of the American West - from quintessential cabins and crude
plows, to early irrigation efforts. As Great Western Sugar entered the landscape, Ferril offered
time-lapse shots of the life cycle of sugar beets, juxtaposed with bustling small towns, beet
factories, and happy children on the playgrounds of schools made possible by Great Western’s
successes. To show that these benefits of industrial agriculture were constantly being built upon,
“The Great Western Story” then moved to recent advances in sugar beet farming. There were
several close-up shots of new cultivators and beet harvesters that mechanically thinned,
cultivated, and harvested beets while the narrator exclaimed, “…old-time hoe-and-finger

3 Thomas Hornsby Ferril, prod., The Great Western Story, 16mm, (Denver: Great Western Sugar, 1955),
Thomas Hornsby Ferril and Family Papers, WH 1195, Western History Collection, The Denver Public Library.
4 Ibid.
thinning can be entirely eliminated.” The film offered glimpses into the work of agriculturalists and chemists at Great Western’s experimental farm in Longmont where serious-looking scientists attempted to improve beet yields and extract more sugar from each plant. The viewer was then treated to the factory processes that produced sugar, emphasizing how new technologies enabled Great Western to produce a host of byproducts from sugar beets, including various grades of molasses and food additives such as monosodium glutamate (MSG). Finally, the film extolled the virtues of beet byproducts in the feeding of livestock, emphasizing how Great Western’s efforts yielded beet pulp and silage with greater feed value and transportability.

Ultimately, Ferril produced a film that situated Great Western Sugar at the forefront of the development of the American West – and the Colorado Piedmont in particular - arguing that it would remain vital for the region’s future.5

Despite a compelling narrative, Ferril’s film virtually ignored a pivotal dimension of Great Western’s history: the contract laborer. The film’s emphasis on progress, as well as the recent mechanization of the beet sugar industry made this possible. Though “The Great Western Story” is packed with scenes of growers, agronomists, chemists, and company executives, there were only three brief scenes that showed contracted laborers in the fields. Their portrayal is telling. In all three scenes, they were working in groups of four to ten, alternately thinning, hoeing, or harvesting sugar beets. Each laborer wore a broad-brimmed hat pulled tightly over the face, shielding the worker from both the sun and the camera’s gaze. In fact, the film only once offered a glimpse of a worker’s face, and that only momentarily. Each of the workers was either bent over or kneeling on the ground. All wielded a hand tool - either a hoe or a knife. And, each of their movements were methodical - thinning, weeding, and slicing – like a well-

5 Ibid.
trained worker whose motions were calibrated to the rhythms of an assembly line. Though brief, these three scenes offered seamless segues that told a story of progress whereby hand labor and those performing it were no longer needed.  

For workers in the sugar beet fields to be so easily replaced, they had to occupy a marginal position on the Piedmont. From 1901, when the first beet factory was built in Loveland, until the early 1950s, when Great Western began its Golden Anniversary preparations, the company and its growers sought out unskilled laborers who occupied the fringes of society, willing to do hand labor for long hours under the hot sun. To maximize labor, the company targeted laborers who were willing to contribute the efforts of their entire family. Using a bevy of labor agents, Great Western hired recent German immigrants from Russia, small numbers of Japanese-Americans, and, after World War I, a growing number of Hispanics, and Mexican nationals. These hand laborers not only occupied marginal positions in society, but their migration, work, and daily lives were intimately tied to the growth of industrial agriculture on the Colorado Piedmont and beyond.

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6 Ibid.
7 Since German-Russians, Hispanics and Mexican nationals provided, by far, the largest source of labor for GWS, this chapter focuses primarily on these groups. Hispanic laborers who worked in the beet fields of the Piedmont came primarily from northern New Mexico and southern Colorado and could trace their presence in those regions to the period before the Treaty of Guadalupe-Hidalgo in 1848. By referring to themselves as Hispanics, they were both embracing their Spanish heritage and distinguishing themselves from laborers imported from Mexico. In studies of the Southwest, Katherine Benton-Cohen, Neil Foley, and David Gutiérrez have shown that the referent ‘Hispano’ was common in New Mexico and Colorado, but less common in Texas, Arizona, and California. In cases where it is clear that my sources refer to laborers imported from Mexico, I will use the term Mexican national(s). However, many of my sources simply refer to Mexicans because Great Western Sugar and most Piedmont residents made no distinction between Mexican nationals and Hispanics. Where no distinction is clear, I use the term ‘Mexican,’ since it is the term used by my sources. On variations of nomenclature see Sarah Deutsch, No Separate Refuge: Culture, Class, and Gender on an Anglo-Hispanic Frontier in the American Southwest, 1880-1940 (New York: Oxford University Press, 1987); Katherine Benton-Cohen, Borderline Americans: Racial Division and Labor War in the Arizona Borderlands (Cambridge, Mass: Harvard University Press, 2009); Neil Foley, The White Scourge: Mexicans, Blacks, and Poor Whites in Texas Cotton Culture, American Crossroads 2 (Berkeley: University of California Press, 1997); David Gutiérrez, Walls and Mirrors: Mexican Americans, Mexican Immigrants and the Politics of Ethnicity (Berkeley: University of California Press, 1995).
The marginalization of laborers on the Piedmont possessed economic, spatial, cultural, and social components. Economic marginalization began with wages. Laborers, most of whom were drawn from German-Russian, Hispano, or Mexican national communities, were primarily contracted by Great Western Sugar to complete thinning, cultivation, and harvesting operations from late May through early November. Though wages could be negotiated, most growers utilized the annual contract drawn up by Great Western, which allotted a set dollar amount for thinning, cultivating, and harvesting each acre. Great Western and its growers deliberately depressed wages in order to obtain the labors of entire families. So, although only the male head of household signed annual contracts to perform the agricultural operations on dozens of acres, all parties involved knew that completing those operations required putting wives and children into the fields. But economic marginalization did not stop there, for the weak bargaining position of laborers and the structure of contracts themselves presented degrees of insecurity. Growers could hire additional laborers to carry out any sugar beet cropping operations, and then charge the labor costs against the wages they would have paid the contracted laborer. If poor weather, or an unexpected infestation of weeds or insects struck, growers were insured against some of those costs while laborers paid them out. Finally, it was not uncommon for workers to go unpaid until long after the harvest season was over. Though local courts were legally bound to hear cases of wage fraud, they were commonly loath to prosecute the same growers who operated within their social and community circles. Thus, contracted laborers and their families found themselves on the economic fringes of the Piedmont with few resources to change that status.

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8 McWilliams, *Ill Fares the Land*, 124; Thomas F. Mahony, *Problem of the Mexican Wage Earner* (Denver, 1930).
Poverty often emanated from spatial marginalization. Most contract laborers lived in dilapidated housing on growers’ property during the sugar beet crop cycle. Referred to derogatorily as beet shacks, the dwellings generally contained two rooms that functioned as kitchen, dining room, and sleeping space. With uneven wood plank floors and tar paper roofs, they were notoriously leaky and attracted plentiful mosquitoes, especially when growers were irrigating their fields. Owing to long days in the fields and the distance of farms from population centers, laborers and their families interacted little with the larger Piedmont society. During the off-season, some laborers found odd jobs locally, but most moved away from the rural districts of the Piedmont. While some returned to extended families in the American southwest, and others to Mexico, many wintered in the deliberately segregated neighborhoods of Denver, Pueblo, Fort Collins, or within one of the smaller towns of the Piedmont. Regardless of locale, the spatial segregation present during the period when laborers and their families were contracted to care for sugar beets from May until November was reinforced during the off-season.

School offered the most common sites where culture and social marginality were on display. Since children of beet workers participated in thinning operations in May and June, as well as harvesting in October and November, they often missed at least one-quarter of the school year. When they arrived at school in the fall, it was common for children to be underweight and lethargic, owing to the strains of the harvest and family relocation. Many German-Russian and Mexican children spoke limited English as well. Classmates and teachers harbored a host of racial stereotypes that stigmatized the newcomers alternately as lazy, greedy, or socialist. For reasons that may or may not have related to education, it was common for children of beet laborers to be held back multiple grades and to later drop out of school. Their outsider status was spotlighted by progressive attempts at the national level from the 1910s through the 1930s to
reform child labor and enforce school attendance. Since poor school performance and child labor mapped onto one another on the Piedmont, the region became a magnet for social research by child labor advocates, sociologists, and reformers of all stripes. The studies they produced are pivotal for understanding how industrial agriculture and economic dependency conspired to marginalize agricultural laborers and their families. Most studies during the 1910s and 1920s on the children of Piedmont beet workers aimed at improving the lives of children, but compartmentalized proposed solutions within the public schools and within the families of ethnic laborers. Those studies argued that better enforcement of school laws, and teaching American values to migrants would improve education and help children assimilate into American society. Other studies – especially those conducted beginning in the late 1920s by nationally known academics and social critics such as Carrie McWilliams and Paul Taylor – as well as the advocacy of Piedmont organizations such as Thomas Mahony’s Mexican Welfare Committee argued that culpability for child labor rested in the hands of industrialized agriculture. They pointed out that the marginality of field laborers and their families was in part a function of the contract labor system, and the greed of Great Western, its growers, and investors. Social reform, they argued, began with reforming and regulating the system of industrial agriculture that relegated families to the fringes of society.

Any economic discussion of labor in industrial agriculture begins with productivity and profit margins and leads eventually to reducing the cost and visibility of its labor force. Great Western’s phenomenal growth in its initial decades of operation was built on marshalling capital to build sugar refineries and attract growers, utilizing state and federal sugar beet research to increase productivity, and taking advantage of a generous tariff that protected the beet sugar industry from cheap imported sugar. It was also a sugar empire made more profitable by the
company’s systematic efforts to locate and employ workers pulled from society’s margins. Consequently, Great Western invested large sums of money and employed dozens of labor agents to recruit laborers willing to accept the physical demands of the industry at low wages during select periods of the year, and then disappear for the remainder.

Understanding marginalized agricultural labor requires a focused look at how laborers related to the land that occupied so much of their time. Prior to the advent of sugar beet agriculture, farmers and their families played the dominant role in caring for the land. Through trial and error and years of experience, they learned its soils, water requirements, and what could be grown where. The move to sugar beet agriculture and contract labor placed a new set of workers and prerogatives on the land. Hand laborers occupied beet fields for many more hours than growers did. The tasks they performed – chopping, digging, hoeing, pulling – for very defined periods of time each year were not calibrated to give them a holistic knowledge of the land. Moreover, since beet labor was migratory, most beet workers did not return to the same fields annually. Their job was not to know and care for the land, but to maximize yields in one very finite period of time.  

It is tempting to view marginalized labor as a natural outgrowth of commercial agriculture. In this view, the industrial and transportation revolutions of the late nineteenth century pushed farmers to focus more on commodity crops that could be moved into the consumer marketplace. Rail lines, commercial canning, and refrigeration enabled farm products to reach more distant retail markets throughout the year. The possibility of greater profits pushed family farmers and commercial operators to buy more acres and plant crops that could fetch high

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prices in far-flung markets. The heavy demands of these farms required wage laborers; the farmer and the farm family were not sufficient. The need to keep costs down implied that wages needed to be low, with the result that the farm sector looked to the fringes of society for its workers. The story has an internal logic that eludes culpability. While the narrative correctly places responsibility for a growing underclass of laborers on a changing American economy, it obscures the role played by farmers, corporations, local boosters, and the state in labor’s marginalization.¹⁰ The development of a marginalized agricultural labor force was neither evolutionary nor organic. It arose out of choices made by a clearly defined set of actors.

Sugar Beet agriculture on the Piedmont offers a clear example of the choices and contingencies involved in attracting a labor force. The Chemistry Division in the U.S. Department of Agriculture (USDA), under the leadership of Hervey Wiley, had been performing experiments on the suitability of sugar beets for American soils since 1880. While promoting the vegetable, the USDA acknowledged that beets required a large labor force.¹¹ During the 1890s, when experiment station researchers at Colorado Agricultural College (CAC) performed a host of experiments on the suitability of sugar beets for the Piedmont, they admitted that the crop had labor requirements that could not be met by small farmers. They assured farmers that such a labor force had been found wherever sugar beets were grown in the past, and could easily be found in Colorado from among a local pool.¹² This was a case of willful deception. The vast majority of Piedmont residents owned their own farms. Even among town dwellers, most made

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¹² Wells Cooke and William Headden, *Colorado Experiment Station Bulletin* 42, no. 3 (1898): 29.
their living in industries that supported the agriculture that already existed. Moreover, the heavy physical demands and temporal nature of hand labor in sugar beet agriculture mitigated against finding locals willing to engage in it. Sugar beet boosters and farmers in Piedmont communities such as Loveland, Longmont, and Greeley were well aware of the need for a labor force that did not exist even as they promoted the industry. They were conscious that labor would have to be imported and that it would have to be drawn from society’s fringes owing to its physical demands and seasonal nature.¹³

There was little that was organic about the evolution of beet labor on the Piedmont. When Great Western built its first factory in Loveland in 1901, its operators were not taking the next logical step in the evolution of Piedmont agriculture. Though beets were suited to the region, Great Western inaugurated an industry that had no agricultural roots in the region and employed growers with little or no experience in the crop. They built factories where none had existed and arranged immediately to find the labor necessary for farm and factory. From its origins, sugar beet agriculture was organized and built on the need for a sizable labor force and drawn from society’s fringes. And, whether they admitted it or not, all of the industry’s organizers were conscious of this fact.

Though many workers migrated to meet the new labor needs of the Piedmont, no group had a greater impact from 1901-1920 than German-Russians. Their ethnic identity was rooted in a migratory past. Seeking to bring vast unpopulated areas of the Russian Empire under state control, Catharine the Great issued a manifesto in the waning days of the Seven Years’ War in 1762. Targeted at the modern nations of Europe, it enticed would-be settlers with tax

¹³ Examples that show this knowledge of the labor needs of the beet sugar industry can be found in A. Hunter Dupree, Science in the Federal Government: A History of Policies and Activities to 1940 (Cambridge, Mass: Belknap Press of Harvard University Press, 1957), 176–180; Colorado Agricultural Bulletins 7 (1889), 11 (1890), 14 (1891), 23 (1893), 43 (1898), and 51 (1899); Ranch and Range, 3, no. 12 (1902), (Denver: H.S. Groves, n.d.), 5-33.
exemptions, free land, limited self-government, exemption from military service, freedom of religion, and the payment of travel expenses. Amongst those who accepted the call to immigrate were 27,000 Rhineland Germans. Settling in the treeless steppes along the Volga River, they grew potatoes, wheat, rye, various grains, and even small quantities of sugar beets – all crops that would be familiar to a Plains settler a century later.\(^\text{14}\)

Russian nationalism and economic problems in the late nineteenth century eroded the autonomy of the German-Russians and ended their relative isolation from the rest of the Russian Empire. Many German-Russians left as a result. In the 1880s, Czar Alexander III promoted a policy of “Russia for the Russians.” Seeking to identify the state with ethnic Russians, he targeted groups on the fringes for ‘Russification.’ Consequently, German-Russians lost their rights of self-governance and their tax-exempt status. They were required to learn Russian, embrace the Russian Orthodox Christianity, and serve in the military if called upon. Since the majority had not learned the Russian language, and many came from pacifist religious traditions, such as that of the Mennonites, few were willing to submit to the new requirements. As the Russian world closed in on them, they also suffered from increasing crop failures after 1875, in part due to drought, but also as a result of over-farming and lack of attention to soil health. The stage was set for another migration.\(^\text{15}\)

Several factors made the Great Plains an attractive region in which to settle. For starters, its climate, topography, and agriculture mirrored that of the Volga region. Further, German-Russians were attracted to the possibility of cheap land, an idea spread into the Volga by American railroad agents who sought to populate regions where they were laying track.

\(^{14}\) For a thorough account of the experience of Germans in Russia, including their reasons for immigration to the Americas, see Timothy J. Kloberdanz, *The Volga Germans in Old Russia and in Western North America: Their Changing World View* (Lincoln, Neb: American Historical Society of Germans from Russia, 1979).

\(^{15}\) Ibid.
Immigrating as families into places such as Nebraska and South Dakota in the 1880s, most discovered that good land was not as cheap and available as they were led to believe. Consequently, they found jobs on the railroads, or moved into cities such as Lincoln and Denver. As their numbers grew, they were able to pay for the transport of relatives and friends, with migrations occurring from 1890-1892, and then a much larger influx from 1898-1913.16

Their background and timing of their immigration enabled them to adapt to the needs of the new sugar beet industry. In 1889, Henry Oxnard opened a beet sugar refinery in Grand Island, Nebraska and local farmers pledged to plant several thousand acres in beets. German-Russians provided a steady pool of labor for the new industry at the same time that employment on the rails were slackening. Many hoped that hard work in the beet fields would yield enough money to buy the sort of land that had attracted them to the Plains initially. When Great Western opened its first factory on the Piedmont in 1901, it was happy to transport these new immigrants to the region’s sugar beet fields.17

German-Russians provided an ideal source of labor for the new beet sugar industry. As newcomers from Eastern Europe, they were on the fringes of an American society that viewed them with suspicion.18 Though many of the male heads of households spoke sufficient English, it was common for wives to speak primarily German, learning only what English was necessary to get by. In addition, they were already accustomed to sugar beet agriculture, having farmed root crops such as potatoes and beets in Russia and on the Plains of Nebraska. Moreover, they

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18 Much of the literature on this subject centers around the degree to which immigrants from Eastern Europe were deemed as fit for assimilation into American society and could adopt the tenets of democracy. Works on this subject include John Higham, Strangers in the Land: Patterns of American Nativism, 1860-1925 (New Brunswick, N.J: Rutgers University Press, 2002) and Matthew Frye Jacobson, Whiteness of a Different Color: European Immigrants and the Alchemy of Race (Cambridge, Mass: Harvard University Press, 1998).
were motivated by a desire for continuity with the agricultural life they had left in Russia. Thus, most were more than happy to take jobs in the fields, hoping that it would eventually propel them to land ownership. In short Great Western and its growers were importing a labor force that was experienced, motivated, and marginal.  

The German-Russians’ suitability for the beet fields was accentuated by familial factors and by the nature of the beet labor contract. Though beet laborers were typically transported to the Piedmont by Great Western, they signed labor contracts with growers. Those contracts were based on the number of acres a worker was willing to take on. Contracts specified that the laborer would thin, cultivate, and harvest a specific number of acres in return for compensation. Contracts did not state who would do the work. They were based on its completion. Thus, Great Western and its growers assumed from the start, that the labor would be completed by an entire family, not just by the male head of household who signed the contract. Again, German-Russians personified industry needs. On average, more of them married, and at a younger age, than the typical resident of the United States. Further, the average family had close to five children. Consequently, German-Russians could supply the needs of a labor-intensive industry simply by the sheer size of their families. Incomes varied widely, but a family with five children would generally contract to thin, cultivate, and harvest at least fifty acres, and earned an average of $500 for a season. Thus, it appeared on the surface that the Piedmont’s beet sugar industry sustained fair wages for its farm laborers. In reality those earnings were borne on the backs of entire families.

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20 Hattie Plum Williams, A Social Study of the Russian German (Lincoln, Neb: American Historical Society of Germans from Russia, 1984); Wyman, Hoboes, 170–198.
Housing and living conditions exacerbated the marginality of laborers. As with contracts, Great Western left the details to the growers. During Great Western’s first year of operation on the Piedmont in 1901, fifty-four German-Russian families signed contracts to complete some of the necessary hand labor. Eight years later, there were nearly 11,000 contracted hand laborers – mostly German-Russians - working in Piedmont beet fields – including women and children – forming more than half of the total labor force.\(^{21}\) Since hand labor required more than ten hours each day in the field, and there was little or no housing available nearby, beet workers lived on-site. To save money, growers developed all sorts of makeshift housing, from providing spaces in their barns, to tents. But, within a few years, most growers erected dwellings derogatorily referred to as “beet shacks” on their properties. The most commonly reproduced shack was 14x20 square feet and boasted 336 square feet of living space. It possessed two rooms, one that functioned as kitchen, dining room, and living area. The other was a bedroom intended for the entire family. The shack was enclosed on all sides and possessed two windows, wood plank floors, and a tar paper roof. Beet shacks were situated next to the fields and, since growers used flood irrigation, insects such as mosquitoes were common. Families often were faced with the uncomfortable choice of opening doors and windows to increase ventilation – and insect populations – or closing their dwellings, which minimized pests, but compromised airflow.\(^{22}\) Housing clarified the place of hand laborers. Being placed in the midst of the fields and affording no clear separation from its pests, it was clear that their value resided solely in their labor. Moreover, since little or no remunerative work remained once beets were harvested – and shacks were rarely built to survive harsh winters – their presence was meant to be temporary.

Though living and working arrangements varied from the end of harvest until mid-spring, when families returned, beet laborers generally remained on the periphery of Piedmont society. Since most German-Russians aimed to purchase land on the Piedmont, they generally tried to remain in the region. Some were fortunate enough to find additional work for Great Western - unloading beets at factories - though their immigrant status defined them as not ‘American’ enough to rate employment inside factory walls. Still others found work on Great Western’s network of rails. Those who resided in Denver sought work at one of the city’s smelters or sorting potatoes and beans in one of the city’s agricultural processing facilities. Women occasionally found work as domestics. While the nature of their housing varied, German-Russians invariably lived in neighborhoods with other German-Russians. Each neighborhood was on the outskirts of town, or across the river or railroad tracks from the rest of the population. Though German-Russians were ethnically German, nearby residents gave the neighborhoods they lived in Russian monikers such as St. Petersburg or Little Russia. Thus, whether German-Russians found work or not during the off-season, Great Western’s labor recruiters knew where to find their pool of workers in the spring.  

Ironically, the marginal status of German-Russians in the fields and the geographic isolation of their living spaces contributed directly to the source of their greatest visibility – the public schools. The beet harvest generally commenced in early-to-mid-October and finished in mid-November. Though labor requirements varied from one family to the next, children ages six and up generally labored six days a week. They were absent from school for this entire period. Many did not attend school in September either, especially if their seasonal housing was particularly distant from a school. In addition, once harvest was complete, families required

some time to move into their off-season housing before sending their children to school. In Great Western’s territory, the children of beet workers missed an average of 33 out of the first 60 days of school, and 25% of the entire school year.\textsuperscript{24} When they finally showed up to school, reports from teachers indicate that many were lethargic and underweight due to the strains of the harvest. Consequently, it was common for them to be held back a grade level. They were stigmatized as “retarded” if they were two years or more behind grade level. In a 1917 study of Weld County, where the largest concentration of beet growers in Colorado resided, over 49% of German-Russians were retarded in 1917, and only 4.8% of their entire population finished eighth grade. The same study claimed that over 90% of German-Russian retardation was caused by work in the fields during the school year. Beet workers emerged from the shadows of obscurity when their children were stigmatized in the public schools.\textsuperscript{25}

The children of beet families received additional attention from national progressives as well. While the forces of industrialization pulled children into dangerous and debilitating work in manufacturing, most progressives initially overlooked the reality that three-fourths of all working children under the age of sixteen were toiling in farms and fields, not factories. Historian Kriste Lindenmeyer argues that this failure came from the persistent belief that most children still worked on family farms, and that the type of labor performed was healthy for their development, stimulating rather than detracting from their social and educational progress. Few Americans in the early twentieth century were willing to accept that the family farm ideal had largely been replaced by factories in the fields, and that children were featured in its labor milieu.


\textsuperscript{25} Colorado, County Court (Weld County), and Juvenile Department, \textit{The Farm and the School, a Resumé of a Survey of the Public Schools of Weld County, Colorado}. (Greeley, Colo.,: Issued by the Extension Dept. of Colorado State Teachers College, 1918).
The federally sponsored National Child Labor Committee (NCLC) confronted this misperception. Its progressive founders argued that childhood was a right, and fought against “any work done by children that interferes with their full physical development, their opportunity for a desirable minimum of educations, or needed recreation.” They targeted employment at unfit ages, unreasonable hours, and dangerous working conditions. Its members generally agreed that fourteen was the earliest age at which children should be allowed to work. True to their progressive roots, they believed that science could best tackle the problem head-on. So, they commissioned a series of sociological studies from the 1910s to the 1930s that highlighted the abuses wreaked by child labor in the fields. One of their first studies centered on the beet fields of Colorado.26

In 1916, child welfare advocate Edward Clopper, and sociologist and photographer, Lewis Hine – both of NCLC - published a report charging that child labor in the beet fields not only damaged the physical and intellectual development of children but tore at the fabric of the local community’s ideals. Since the majority of school days lost occurred during the harvest, Clopper and Hine focused most of their attention on that period. They observed that the average sugar beet weighed from 10-12 pounds when pulled from the earth and that the typical child between 6 and 16 yanked between 12 and 15 tons of beets during a day that often stretched from 6 am to 6 pm. The exhaustion not only put excessive strain on their bodies but constantly threatened injury since every beet had to be topped. This involved bracing the beet against the knee, then striking a sharp blow with a curved knife to remove the beet top. Fatigue often led to injury. Consequently, when the children of beet workers finally arrived at school, they were exhausted, unprepared, and woefully behind in their studies. Not only did this impair their

education, but it exacerbated the discrimination they suffered due to their immigrant status. Hine and Clopper went on to argue that regular school attendance was necessary to address the isolation and discrimination suffered by children in the beet fields. Finally, they posited that truancy eroded local communities. At the most basic level this involved the flouting of school attendance laws, thus defying the “will of the people.” They also nodded to the assimilatory power of education, arguing that thriving local communities went hand-in-hand with educational systems where immigrant children were exposed to those who were not like them. Clopper and Hine concluded that child labor in the beet fields and its impacts on school attendance were societal problems.27

Two years later, the Colorado Teacher’s College published a study focused on Weld County that concentrated entirely on education, arriving at more developed conclusions. The study’s primary author, Weld County Judge Herbert Baker, agreed with Clopper and Hine that school attendance was a societal problem. He stated that beet farming communities were too apathetic and that, if they put pressure on school districts to compel attendance, the problem would diminish. He suggested that some teachers and truancy officers were afraid to speak out about the lack of attendance since the local community relied so heavily on children for hand labor. But while Baker indicted school officials and child labor, he never once mentioned children working in the beet fields in his entire report. In one instance he tried to explain the tension between labor needs and education by describing children working in the potato fields in the fall. While Colorado certainly grew its share of spuds, no one would deny that, when agriculture caused truancy, the crop involved was far more likely to be beets than any other.28

27 Clopper and Hine, Child Labor in the Sugar-Beet Fields of Colorado.
28 The Farm and the School.
Baker’s partner in the study, Edgar Randolph, sociologist at Colorado Teacher’s College, situated his arguments amidst the larger national push to Americanize immigrants. Identifying beet families simply as Russians, Randolph stated that they were the least familiar with American democratic institutions of all immigrants in Weld County and that the initial years of public school were the most crucial ones to “make us alike.” Further, Randolph argued that intelligence and the adoption of democratic ideals were intertwined processes and school attendance promoted both. If Baker and Randolph were to be believed, then truancy due to child labor in the fields prevented thriving schools, healthy communities and a democratic nation.

Despite a reformist tone, both studies failed to adequately address child labor since they never mentioned Great Western Sugar. At the heart of child labor in the beet fields was a labor contract that implicitly required families to employ their children in the fields for periods of time in order to subsist, and for long hours if families ever hoped to move out of seasonal labor and into land ownership. The physical ailments suffered by children – and laborers in the beet fields in general – were a function of the long hours necessary to thin, cultivate, and harvest beets in a fashion that would promote larger harvests and meet the demands of beet sugar factories. Overworked, children frequently hurt themselves while cutting off beet tops with curved knives, suffered physical deformities from stooping in the fields for long periods, or simply succumbed to an exhaustion that precluded school participation. At the heart of the system were investors and growers who hoped to maximize profit. Since hand labor was the most significant

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29 Randolph’s use of ‘Russian’ to describe German-Russians betrays two facts in how the new immigrants were perceived. Since they emigrated from Russia, most residents on the Piedmont referred to them by their immigrant status, not their ethnic background. Since the study was published in 1918, the reference may have reflected the exigencies of war, since the United States was at war with Germany, but remained an ally with Russia. German-Russians suffered a raft of discrimination during the conflict. Since Randolph was most interested in assimilating German-Russians, he may have consciously chosen the least inflammatory reference. See *The Farm and the School*.

30 *The Farm and the School*.

31 The Clopper and Hine study re-prints a standard beet labor contract in the appendix where Great Western’s name is used, but their company is never referred to in the text.
investment between planting and harvest, both parties sought to lower their labor costs as much as they could while still attracting necessary workers. Communities, including the teachers, school board members, and judges charged with enforcing attendance laws, were all attached to sugar beet agriculture and the corporation that brought more money into the local economy than any other. Thus, to suggest that the form of labor Great Western employed was at the heart of their educational woes and needed reform was to place their economies in jeopardy. So, the solutions offered by educators and community leaders - reforming school boards, empowering teachers and judges, and compelling locals to care more about truancy – were purposely delimited by the labor demands of Great Western and its growers. It would not be until the 1920s when labor reformers and child advocates began to target the institutional foundations of child labor and school attendance.

Despite the reticence of community leaders to address the ills of contract labor in sugar beets, Great Western still felt it necessary to absolve itself from wrongdoing in the child labor and education debate. In 1916, it printed an article in its grower magazine, *Through the Leaves*, to answer critics. Written by Harvey Riddell, a Larimer County School Board member and Great Western field supervisor, the article agreed that children should be in school, but it placed much of the blame for child labor and poor attendance on the immigrant families themselves. Though never actually naming German-Russians, he stated that immigrant workers were possessed of “greedy ambition,” and that they put their large “capital stock” – children – into the fields for the sake of “money getting.” Riddell went on to argue that the typical immigrant arrived on the Piedmont with the same chance of getting a job as any “native,” but that he “voluntarily lowers (his wage) with the expectation of working his children. He is used to a more frugal method of living, therefore a lower wage.” Riddell advanced the tendentious claim
that, for their time in the fields, hand laborers earned as much as growers. While there was some truth to this, his figures compared wages earned by an entire family of seasonal workers to those of a grower, who only infrequently required the services of his immediate family in the fields. Neither did Riddell’s assertion account for the periods of the year when beet laborers struggled to find employment elsewhere. Riddell also included in his wage calculations the fact that laborers received free housing, without also accounting for the crowded and dilapidated nature of those dwellings. Finally, Riddell posited that immigrant laborers were too “clannish” and that assimilation would solve many of the Piedmont’s labor issues. Arguing that “race improvement” emanated from the sort of “proper moral and religious training” provided by the schools, he concluded that immigrant parents must “forego the idea of working their children,” and schools needed to enforce their current attendance laws.32

As with the previous articles, Riddell studiously avoided the role of industry in fostering child labor and school truancy, instead finding culpability in the nature of the workers, or failures in the school system. By failing to mention Great Western’s deliberate recruitment of large families of German Russians, he suggested that they arrived on the Piedmont completely of their own volition. In stating that they competed on equal terms with the “natives” of the region, he implied that there was a ready pool of local workers willing to do hand labor in the beet fields. In reality, immigrants were deliberately targeted for work in the beet fields through a network of Great Western labor recruiters because of their large families, and because their marginal place in the United States and lack of resources pre-conditioned them to accept the physically demanding labor that locals were unwilling to do – a fact pointed out elsewhere in Through the

32 Harvey Riddell, “Juvenile Beet Labor and the Public School,” Through the Leaves (hereafter TTL) 4, no. 5: 184.
Leaves. Riddell’s claim that immigrant laborers were motivated by “money getting” and that they lacked “proper moral and religious training” falsely situated labor problems within a taxonomy of race. The desire of many German-Russians for land was no different than that of the vast majority of others who had settled on the Piedmont in previous generations. The “greedy ambition” that pushed children into the labor force was aimed at obtaining the same goal of land ownership that those before them possessed.

Riddell’s argument unraveled within one of his truest statements, instead providing a case for Great Western’s culpability in child labor and school attendance. He pointed out that when immigrants eventually become tenants and landowners, they employed hand laborers after the same fashion as the growers who once employed them. Of course they did. During the course of their transition from hand laborer to grower, immigrants learned that family labor was at the heart of the beet sugar industry. The need for an army of hand laborers, as well, competition from cheap imported cane sugar, and Great Western’s desire to maintain large profits demanded that those working in the fields be drawn from the lowest rungs of society. Each hour of their labor could be devalued if their entire family worked in the beet fields. This strategy precluded children from attending school during important cultivation and harvest periods. The fact that German-Russian landowners reproduced the same labor system they were once subjected to suggests that they had learned the internal logic of industrial agriculture: that cheap labor drawn from the fringes of society produced the greatest returns. And, since entire communities relied on that labor for their sustenance, few were willing to tackle the institutional problems at the heart of their educational systems. Consequently, the educational system made the problems of

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child labor and marginal immigrants visible, but reformers stopped short of addressing its root causes.

Though German-Russians performed the majority of hand labor in the sugar beet fields for most of the first two decades of the twentieth century, their family labor, along with international events and increased wages over time, enabled many of them to become growers, creating a labor void for a new marginal labor force to fill. A common phrase German-Russians had carried from Europe was “Arbeit komm her, ich fress, dich auf!” (“Work, come here, I will devour you!”) That attitude motivated long hours of labor, and the employment of entire families in the beet fields. Having arrived in America seeking agricultural land, many utilized their wages to move quickly from laborer to tenant to owner. That process was at its most pronounced during and immediately following World War I. The eruption of the Great War in 1914 immediately cut off immigration from Europe, resulting in a labor shortage. The war also decimated Europe’s beet sugar industry, creating a worldwide shortage at the same time that sugar was in high demand by troops fighting in the conflict. With sugar and labor in high demand, field laborers could command higher prices for each cultivated acre, a trend that continued for two years following the war. This propelled an even greater number of German-Russians into land ownership. Great Western, recognizing that it no longer had access to its European pool of immigrants, sought labor closer to home.

Hispanos and Mexican nationals were recruited to fill the labor vacuum. This was not without precedent on the Piedmont, but the scope and nature of the recruitment would have

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profound consequences for the region’s labor regime and the construction of race. In 1903, Great Western recruited 275 Hispanics from southern Colorado to increase the labor supply during the beet sugar industry’s initial growth period.\textsuperscript{37} For the next decade, small groups of these internal migrants worked in the beet fields with the majority of them returning to their communities in southern Colorado and northern New Mexico during the winter season. When World War I constricted the labor pool, Great Western actively targeted Hispanics to replace them. Unable to attract significant workers within the borders of the United States, Great Western began importing Mexican nationals. Initially, these recruits were primarily single men who contracted to either thin, cultivate, or harvest beets. However, by the end of the war, when it became clear that these new laborers would occupy the void left by German-Russians, Great Western recruited entire families. By 1920, an even number of Hispanics and Mexican nationals were working in the beet fields, providing 40\% of the hand labor, and totaling 90\% of all migrant labor. In that year, Great Western employed twenty full time labor recruiters and spent nearly $200,000 to transport laborers to the beet fields. By the mid-1920s, Mexicans comprised over two-thirds of the hand labor force, and Great Western employed thirty-five labor recruiters who concentrated their efforts primarily in the Southwest and in several recruitment centers in Texas and northern Mexico.\textsuperscript{38}

Immigration status played a significant role in the transition, offering insight into how racial attitudes permeated labor status. During the Progressive Era, attitudes about the influx of Eastern Europeans often centered on the question of who was capable of assimilating into American society and concerns that some immigrants were either a danger to American


democratic institutions or would become wards of the state.\textsuperscript{39} These attitudes informed the Immigration Act of 1917, which contained an English literacy requirement and a doubled head tax on immigrants. The law was intended to screen out those considered incapable of assimilation. Piedmont residents often viewed German-Russians with suspicion since most still spoke German as their primary language in the 1910s, and many refused to cooperate with the school system. This fed into fears over German-Russian loyalty to the United States during World War I. However, the new immigration law and wartime discrimination forced most German-Russians to learn English.\textsuperscript{40} In addition, the fact that so many of them were able to purchase land demonstrated their self-sufficiency and fitness for democracy. Moreover, the transition from laborer to grower enabled German-Russians to send their children to public schools where the stigma of retardation soon faded. Their second-class status had revolved around their marginality in the labor regime. They became Americans in the transition from hand laborer to grower.

The Johnson-Reed Act of 1924, further highlighted the transition within the German-Russian community from hand laborer to grower. This immigration statute placed quotas on immigrants from around the globe. Annual quotas for each nation were based on how many were present in the U.S. in 1890. Since German-Russians emigrated from Russia, they were grouped with the quota on Russia, a nation that had contributed few immigrants to the United States by 1890. Consequently, German-Russian immigration to the Piedmont was virtually eliminated, and residents of the region no longer observed German-Russians moving into hand


\textsuperscript{40} Shaw, “Twice Separated,” 82–104.
labor positions to replace those who had become growers; theirs became solely a transition into grower status.\textsuperscript{41}

The manner in which those same immigration laws addressed migrants from Mexico demonstrates how Great Western and its growers made racial and labor distinctions between German-Russians and Mexicans. Great Western was one among many companies in the West seeking cheap labor - primarily in agriculture, mining and on the railroads. As the labor market tightened during the war they successfully lobbied Congress to make exceptions to the 1917 Immigration Act, eliminating literacy tests and head taxes for migrants from Mexico. Though these exceptions were intended to last only a few seasons and apply only to temporary workers, they were rarely enforced, and many Mexican nationals deliberately chose not to return to Mexico at the end of their contract period.\textsuperscript{42} By the mid-1920s one-third of all Mexicans in the United States worked in agriculture, comprising three-quarters of all laborers in southwestern fruit orchards and vegetable fields.\textsuperscript{43} Thus, it should come as no surprise that the same 1924 immigration restrictions that eliminated German-Russian immigration, placed no quotas on Mexican immigration.

In fact, whereas Great Western and its growers made distinctions for German-Russian laborers as to whether they were capable of assimilating, the sugar company recruited Mexicans in the belief that they would never assimilate. A U.S. Department of Labor study concluded that Mexicans “are not permanent, do not acquire land…but remain nomadic and outside of

\textsuperscript{41} Fred C. Koch, \textit{The Volga Germans: In Russia and the Americas, from 1763to the Present} (University Park: Pennsylvania State University Press, 1977), 212–221.
\textsuperscript{43} Deutsch, \textit{No Separate Refuge}, 117-126.
American civilization.” In other words, unlike the German-Russians, Mexicans could always be relied on to do the backbreaking, low-wage work in the fields, and then disappear when their services were no longer required. In 1920, as Congress debated immigration restrictions, representatives of the beet sugar industry weighed in. They argued that restricting Mexican immigration would be the death of their industry, and strike a significant blow to American agriculture in general since Americans were unwilling to do the physical labor assigned to Mexicans. Making a distinction between themselves and hand laborers, a representative of the beet sugar industry concluded, “you have got to give us a class of labor that will do this back-breaking work and we have the brains and the skill to supervise and handle the business part of it.”

Great Western and its growers affirmed that Mexicans fulfilled their desire for a permanent underclass of laborers. As the chief labor recruiter for Great Western, C.V. Maddux was often called upon to defend this philosophy. Appearing before the House Committee on Immigration and Naturalization in 1928, he stated that he was not worried that Mexicans would ever supplant American farmers. In fact, he implied that this was one of the reasons why Great Western actively recruited them. Knowing that most of the beet lands of the Piedmont were already in production and that there was little room for more growers, Maddux stated that “we no longer want settlers to occupy vacant land…what we want is workers to work for the settler who came before.” Great Western and its growers substantiated their arguments that Mexicans would remain laborers by distilling observations into stereotypes that pervaded the beet sugar

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industry. Viewing that their families were smaller than those of the German-Russians before them and that Mexican mothers and children were less likely to work long hours in the beet fields, growers argued that Mexicans did not want to move ahead, and were unwilling to help themselves in times of trouble. Observing that they had not moved into land ownership, others stated that Mexicans were not thrifty and would not “save for a rainy day.” In his 1929 study of labor in the sugar beet fields, noted University of California agricultural economist Paul Taylor quoted a “college trained farmer” who summarized the prevailing relationship between Great Western, its growers, and Mexicans: “…beets are largely responsible for the development of this country, and the beets require Mexicans.”

Great Western and its growers employed selective memory in classifying the Mexican labor force. From its inception, the beet sugar industry, growers, and boosters on the Piedmont argued that a local labor force could be found to do the work of cultivation, a claim based on a willful ignorance of the lack of available workers on the Piedmont. By the 1920s, Great Western not only actively recruited distant laborers, but also employed a lobby in Congress to maintain its cheap labor supply. Once that labor force was in place, the company and its growers worked to keep it on the margins. This presented a particular irony in regard to the new, Mexican labor force. The evidence used to argue that Mexicans were unwilling to help themselves or move ahead in the world was taken in part from their tendency to work fewer hours and take on fewer acres than their German-Russian predecessors. By contrast, those same German Russians were previously disparaged for assuming large workloads and putting their entire families to work, enabling them to buy land and become growers. Unfortunately, no matter how diligently the new labor force worked, opportunities to become growers were sorely constricted.

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While it was true that Mexican families were smaller on average than their German-Russian predecessors, and that Mexican wives and children worked fewer hours, several factors beyond their control kept them from becoming growers.⁴８ One was the simple fact that the irrigated lands of the Piedmont were among the most expensive agricultural lands in the West, and their value was increasing quickly in the post-war period. Writing in 1919, Great Western executive J.F. Jarrell argued that demand for beet lands was so high that some had doubled in value within two years.⁴⁹ In addition, Mexicans who arrived on the Piedmont were often saddled with debt from the start. Though Great Western paid for their transport, laborers often appeared a full month before thinning season started. To enable the new laborers to establish themselves, Great Western, growers, and retailers often advanced money to beet workers until the end of the season, when they were finally paid in full for their work. Laborers then paid off their debts and routinely left the fields at the end of the season with little money in their pockets and returned the following year in need of further advances. Sometimes called the padrone system, this cycle of debt placed insurmountable walls in front of laborers who hoped to advance their status.⁵⁰

Despite poor living and working conditions, it is impossible to ignore that Hispanos and Mexican nationals still chose to come in droves to work in Piedmont sugar beet fields. Why? Historian Sarah Deutsch has shown that many Hispanos chose to work in the beet fields because of the social disruptions caused by World War I. Some Hispano males fought in the war, while others became migrant laborers, seeking higher wages in the mines and agricultural fields of the Southwest. The war and their presence heightened discrimination against them, and limited opportunities after the war. Labor recruiters from Great Western offered plentiful labor after the

war at wages that were higher than they could make in their towns in southern Colorado and northern New Mexico. And, as a bonus, their families could remain together since Great Western sought entire families to work in the beet fields.\textsuperscript{51} For some Mexican nationals, many chose to migrate in the wake of the tumultuous Mexican Revolution. Though that revolution purported to aid those on the lowest rungs of Mexican society, it nonetheless created hardships for Mexicans from all social backgrounds. Further, since Great Western had recruiters working in Mexico, it is likely that they promised more benefits than labor in the beet fields could deliver. Once communities of Hispanics and Mexican nationals formed within Piedmont towns, newer migrants could find safety and solidarity in existing enclaves. Further, well-organized charities and, during the 1930s, state and federal agencies, provided meager economic safety nets during financial hard times. While Mexican nationals and Hispanics were certainly aware of their second class status on the Piedmont, work in the sugar beet fields offered a tradeoff that many were willing to take.\textsuperscript{52}

While the much resented cycle of debt created by the \textit{padrone} system tied beet laborers to the Piedmont, Great Western employed methods to keep laborers on the Piedmont that were far more welcome by the workers themselves. Beginning in 1922, the company offered lots on company-owned land within each factory district for purchase by beet laborers. The company then provided materials and some supervision so that laborers could build their own houses. Though each beet district varied, the average cost of a lot was about $50, with housing materials costing from $125-$200. This represented approximately one-third of the annual wages of a

\textsuperscript{51} Deutsch, \textit{No Separate Refuge}, 107–161; For an example of the discrimination suffered by Hispanics working in the mines of the Southwest during World War I, see Benton-Cohen, \textit{Borderline Americans}.

typical beet worker family. Great Western loaned money to purchasers who were expected to repay the loan within five years. These small housing developments, called colonias, were usually built of adobe bricks, and contained two or three rooms and a free-standing stove for cooking. Since most of Great Western’s land holdings surrounded their factories, and were separated from town, colonias were typically built near factories and physically removed from the local Anglo population. Great Western and its laborers neither wired homes for electricity nor did they provide indoor plumbing. Typically, the company hauled water to the colonias and stored it in cisterns. Great Western’s investment in the colonias varied by beet district based on land available and demand. The colonia in the Brush district was smaller than the norm and contained 24 lots. On the surface, the colonias were welcomed by laborers and the company alike. Beet workers could own their own homes and remain on the Piedmont during the off-season. Great Western and its growers gained a pool of reliable labor, replacing the costs of transporting laborers to the beet fields each year. By 1930 when Great Western stopped offering lots for sale, nearly one-third of beet laborers lived in colonias.53

The colonias also became a source of labor activism. Historian Dennis Nodín Valdés has argued that a proletarian culture developed within the colonias in the beet districts. It is notable that Great Western’s efforts to hold Mexicans in the region was animated by a need for field laborers and not by any desire to increase its number of growers. A glass ceiling existed separating Mexican field laborers from growers and company executives. The combination of shared living and working conditions created solidarity. That solidarity transcended racial

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divisions between Hispanics and Mexican nationals. By the mid-1920s residents of the colonias took shared actions to protest their living and working conditions. They boycotted retail establishments that discriminated against them, avoided public spaces where they were not welcome, and demanded that Great Western provide better sanitation and drinking water. Though many were illiterate, they occasionally requested that growers re-measure beet fields before thinning them, since laborers suspected that growers were forcing laborers to cultivate more than the contracted acreage. Working-class solidarity also formed in cities such as Denver and Pueblo, where beet laborers lived during the winter and formed their own urban colonias – Mexican neighborhoods dominated by seasonal beet laborers. During the 1920s, the number of residents living in Denver’s three Mexican neighborhoods increased from 2,000 to 8,000, with beet laborers accounting for most of the increase. It would not be long before working class solidarity evolved into union activism.\(^{54}\)

As working class activism formed among within beet laborer communities during the 1920s, other Piedmont residents observed the living and working conditions of seasonal sugar beet laborers with concern. Few of them understood their day-to-day struggles and the barriers to their advancement better than Thomas Mahony. Born into an Irish Catholic family in Ohio, and possessing only a fifth-grade education, Mahony moved to Grand Junction, Colorado in 1902 where he worked as an insurance and real estate salesman, and promoted the purchase and use of heaters for the fruit orchards in the region. Imbued with a curious mind and a strong sense of civic duty, Mahony volunteered to promote the state’s tourism industry by writing letters to support the creation of Rocky Mountain National Park, chairing Grand Junction’s Chamber of Commerce, and representing Colorado in the national “See America First” convention in 1912.

\(^{54}\) Ibid.
He also gained an overview of migrants moving to the state when he was appointed for a two-year term to the Colorado State Board of Immigration in 1910. But it was not until Mahony married and moved to Longmont in 1920 that he gained firsthand knowledge of Mexican laborers in the sugar beet fields of the Piedmont. Mahony was particularly interested in the living and working conditions of the Mexican migrants since most shared his Catholic faith, and since their spiritual and physical needs were not being served by the onerous conditions of their employment. From 1921-1923, as Mexican hand laborers poured onto the Piedmont, Mahony actively observed the beet sugar industry and was appalled by what he saw. As a result, he and several congregants from Catholic parishes on the Piedmont formed the “Mexican Welfare Committee” within the Colorado Knights of Columbus, a Catholic fraternal organization. Their stated purpose was to “improve the religious, social, and economic conditions affecting our Spanish-speaking fellow Catholics,” to address the living and working conditions of migrant workers, and to promote “fair dealing with them.” Mahony chaired the Mexican Welfare Committee and was its most outspoken activist.\footnote{Thomas F. Mahony Papers, University of Notre Dame Archives, Notre Dame, Correspondence and Clippings, Box 1, Folders 1-3, (Hereafter TFM Papers); Rubén Donato, \textit{Mexicans and Hispanics in Colorado Schools and Communities, 1920-1960} (Albany: State University of New York Press, 2007), 14–16.}

Though largely forgotten, Mahony exerted more influence in exposing the living and working conditions of sugar beet field workers in the 1920s and 1930s than any of his contemporaries. And, unlike the social scientists and school workers of the 1910s, Mahony argued that Great Western’s “industrial slavery” in the beet fields was largely responsible for these poor conditions. Authors of several major studies of labor in the beet fields of Colorado during the period consulted Mahony and employed Mexican Welfare Committee data. These include the National Child Labor Committee’s 1925 study of “Children Working in the Sugar
Beet Fields of South Platte Valley,” and the work of Paul Taylor and rural sociologist B.F. Coen of Colorado Agricultural College. In Ill Fares the Land, Carey McWilliams, the most well-known critic of labor regimes in industrial agriculture during the 1930s and 1940s, devoted a chapter to beet workers that employed Mahony’s work. On the strength of Mahony’s publicity, national magazines such as New Republic and the Nation published beet labor exposes. Mahony was also appointed to a White House Committee to investigate child labor, and he contributed to a 1932 League of Nations report on the same subject. He unabashedly paralleled the abuses of factory labor to those in the beet fields, often employing the phrase “industrialized agriculture” to describe not only Great Western’s form of contract labor, but to show how that labor impacted living conditions, education, and racial prejudice in the region.56

Mahony’s sense of justice was heavily influenced by the writings of another Irish Catholic, Father John Ryan. In 1906, Ryan crafted his doctoral dissertation around the idea of the living wage, a concept that provided a rallying point for reformers from the Progressives of the early 1900s to the New Dealers of the 1930s. According to Ryan, a living wage was sufficient for a family head of household to provide his family with the basic necessities of life, and a modest amount of property and possessions. In his 1923 work, The Christian Doctrine of Property, Ryan argued that, though laborers were not entitled to own the means of production, as communists believed, they should nonetheless share in the profits of industry. Further, he

posited that concentration of wealth in the hands of industry was fundamentally immoral since all people possessed equal claims to the earth’s resources and that high levels of wealth inequality robbed the majority of that basic right. Arguing that the most important function of government was the economic welfare of its people, Ryan supported an expansive role for the state in regulating industry, and that further, it should support the efforts of mainstream unions to gain a larger share of society’s wealth for its members. Far from being a political radical, Ryan declared that the best defense against socialism and communism was a fair - though not necessarily equal – distribution of society’s wealth. Mahony’s efforts on behalf of beet workers were infused with that same desire to correct the wealth imbalances between industry and labor, spread property ownership more broadly, and thereby dull radical political impulses.57

To make their case, Mahony’s Mexican Welfare Committee occupied much of its time during the mid-1920s contrasting the economic value of Mexican laborers on the Piedmont with their degraded living and working conditions. According to Mahony, in 1926 there were 15,000 Spanish-speaking beet workers on the Piedmont working 110,000 acres, comprising two-thirds of the total hand labor force. The value of the beets they cultivated and harvested amounted to approximately $13 million. He claimed that the region’s beet sugar industry brought in $33 million worth of business annually, not including the freighting of coal and lime necessary to turn beets into sugar, the long term investments into the building and maintenance of factories, or the money paid to counties in which they were located. Mahony argued that Mexican labors were the vital pivot upon which these eye-popping financial gains were based. Yet, despite their indispensable role, Mexicans, Mahony claimed, were treated with contempt. Piedmont

businesses still displayed signs such as “White Trade Only” and “No Mexican Trade Wanted,” and Mexicans were unable to access essential services in some Piedmont towns. In regard to living conditions, he stated that, though some improvements had been made by Great Western and certain progressive-minded growers, the majority of laborers still suffered from “bad housing, polluted water, lack of screens and sanitation, a great deal of preventable sickness,” high death rates for women and children, and cramped living spaces. On more than one occasion, Mahony argued that the living conditions for cattle on the Piedmont compared favorably with those of Mexican beet workers. In addition, he complained that the criminal justice system was stacked against Mexican beet laborers, as they were fined and imprisoned in disproportionate numbers, with judges and juries given incentives to impose harsh judgments against Mexicans. He concluded that the treatment of Mexicans on the Piedmont eroded much of their dignity, and blamed the “neglect and indifference” of industry and Piedmont residents for their condition.58

Yet, despite their efforts and by their own admission, the Mexican Welfare Committee seemed to effect little significant change in the beet fields during the 1920s. Annually, the Committee sent out several thousand of its reports “dealing with different phases of the “Mexican problem,” to churches, politicians, newspapers, universities, public officials, and a variety of interested organizations. Volunteers from both the Anglo and Mexican communities provided aid and self-help classes in Mexican communities during the winter, when most beet workers had little or no work. The greatest impact these efforts had, according to Mahony, was to dull the efforts of socialist groups such as the International Workers of the World (I.W.W.)

and “Red Socialist Group(s)…under the immediate direction of the Mexican government.” Yet, Mahony stated that few inroads had been made toward eroding the “racial antagonism and indifference” that maintained the migrant workers’ marginality. Mahony’s attempts to meet with representatives of Great Western Sugar to address the wages and conditions of Mexican laborers largely failed. Apparently, Great Western did not hold Mahony or the Mexican Welfare Committee in high enough regard to rate their time.59

Mahony’s attempts to make the labors of Mexican beet workers and their families visible made huge inroads as a result of a published speech entitled, “Wages of the Unskilled Workers in Colorado,” originally delivered in May, 1929 at the Catholic Conference on Industrial Problems in Denver. In the speech, Mahony alluded to many of the ideas about a living wage gleaned from Father Ryan and to the teachings of various Catholic Church leaders. Mahony claimed that a minimum of $1,800 was necessary for a family of 5-6 to live “at a minimum level of health and decency.” Yet, the average annual wages of beet workers, including wives and children, amounted to $600 on average. Mahony further argued that the standard labor contract was both unfair and not always honored. In 1929, Great Western guaranteed a price of $7 per ton of beets for growers and $23 per cultivated acre for workers. As twelve tons of beets per acre was the minimum industry standard, growers stood to earn several times more than hand laborers, even though they spent less time in the fields. Further, Great Western allotted growers an additional $7 for each additional ton beyond twelve; laborers, by contrast, only received $.50 of that bonus. Mahony opined that the “skill, intelligence, and conscientious work” of hand laborers was largely responsible for any bumper crop, yet the financial rewards were disproportionately reaped by growers. After noting the broad earnings disparities, Mahony

transitioned into housing, noting that the labor contract used by most of the growers, and strongly supported by Great Western, stated that “habitable houses and suitable water near at hand for drinking and domestic purposes” should be provided by the grower, and that Great Western was required to verify that growers were fulfilling these responsibilities. Yet, the majority of families continued to live in “one or two-room shacks” that were “poorly lighted and ventilated…not properly screened,” and often lacking sanitary water nearby. Mahony then connected those subsistence living and working conditions with children missing school – despite Colorado’s compulsory attendance laws - to work in the fields, holding Great Western, growers, and public officials responsible for their truancy. Finally, he cautioned his audience about the very real threat posed by socialist labor activists working in the community, stating that living and working conditions eroded the religious morals of Catholic Mexicans, making it possible for those values to be replaced with irreligious radicalism. True to his advocacy of a living wage, Mahony claimed that there was a surplus of wealth created by the beet sugar industry, and that surplus had to be distributed more evenly to the laborers who did the vast majority of work. Only then, it followed, would their families live in frugal comfort, their children receive decent educations, and their appetites for radical political ideas be dulled.60

Several sources help us to map the impact of Mahony’s 1929 speech. After Mahony delivered the speech, the Knights of Columbus printed it and distributed thousands of copies. Many of them were delivered into the hands of leaders within the American Catholic Church. From there, the printed version of the speech found its way into the hands of secular and religious magazines such as New Republic, The Nation, Columbia, La Prensa, and The Tidings, all of which published articles and editorials drawing national attention to conditions in the beet

60 Mahony, “Wages of Unskilled Workers.”
fields of the Piedmont. Mahony found himself in great demand as a speaker, offering the same story under titles such as “Industrial Relations in the Beet Fields of Colorado” and “Mexican Migratory Workers in our Colorado Sugar Beet Fields.” Far from being a lone wolf, Mahony gave credit to various reports in the mid- and late-1920s that provided some of the evidence in his speeches and writings. Those included two reports from the National Child Labor Committee, one by Colorado Agricultural College, and two by the United States Department of Labor. As an activist and a resident of the Piedmont, Mahony gave those reports broader distribution, enlarged impact, and a clearer sense of what societal institutions should be held responsible. Moreover, his was the only loud voice of advocacy that connected conditions in the beet fields on the Piedmont with the concept of a living wage and the fear of communism.61

As the contrast between a living wage and the actual wages of beet workers was gaining local and national attention in 1929 – in part due to the efforts of Mahony and the Mexican Welfare Committee - laborers were confronted by Great Western’s policies and nature’s whims. The climate during fall harvest season in October and November offered a set of potential risks and rewards on the Piedmont as overnight frosts alternated with relatively mild daytime temperatures. Since more time in the ground facilitated higher sugar content, it was in the best interest of Great Western and its growers to harvest their beets as late in the season as possible, but before temperatures dropped low enough to freeze the beet itself, which lay several inches underground. The sugar company also wanted the timing of the harvest to be staggered, since beets lose sugar content when not processed quickly, and the company could not process all of the beets delivered at once. As beet workers began harvesting the largest crop in Piedmont

61 New Republic, 14 August 1929, 323-24; “Pauper Labor and Child Labor,” The Nation, 8 July 1931; Agnes Ryan to Mahony, 13 August 1929, John Donahue to Mahony, 13 August 1929, Patrick Henry to Mahony, 20 August, 1929, Mahony to Emil Kostner, 9 September 1929, John F. O’Neill to Mahony, 19 September 1929, TFM Box 1, Folder 8.
history, the weather turned particularly cold - frigid enough to freeze unharvested beets into the earth. Since beets possess a deep taproot that extends as much as three feet into the ground, beets were slow coming out of the ground and difficult to top. And because the cold temperatures also reduced sugar content, growers and Great Western were in a particular hurry to get them removed. Since the annual labor contract stated that growers could hire additional labor if the hand labor could not be performed in a timely fashion, growers sought out whomever they could find. This hit the primarily Mexican labor force particularly hard since their contract also stated that wages paid to supplemental workers would be deducted from their own wages. One particular hand laborer stated that he was supposed to receive $154 for harvesting 14 acres, yet he had to pay out $70 for additional labor and he still had 3 acres left to harvest before getting paid. Adding insult to injury, several state officials, charity workers, and welfare agencies concurred that many of the laborers were not even paid all of their reduced wages at the end of the season.62

The 1929 harvest offers a case study of the weak position occupied by laborers in the industrialized agricultural workforce. Though Great Western and its growers suffered from the 1929 harvest, labor contracts were written as a form of insurance to minimize loss, with laborers assuming much of the risk. According to Mahony, Great Western and its growers generally did not allow hand laborers to harvest when the weather was still good, hoping to wring that last bit of sugar out of every beet. Consequently, even in years when mild weather held out, laborers completed the harvest during freeze/thaw periods that forced workers to dig beets before each day’s frost had worn off. When it did, laborers became soaked for much of the day as ice turned to water. This was of no consequence to growers since there were no stipulations in the labor

contract that accounted for poor weather. And when poor weather did more than just create miserable working conditions, as it did in 1929, growers could pass the meteorological costs off to the Mexican labor force. Further, the contract specified that laborers would not be paid for the harvest until it was complete, which was typically on or about November 15. However, Mahony claimed a few beet workers had to work into January of 1930 to complete the 1929 harvest.

While articles in the Greeley newspaper thanked laborers for their hard work and for not leaving the fields, that did not stop growers from hiring extra labor and reducing the wages of contracted laborers at the end of the season. The poor season and Mexicans’ powerless position were doubtless central to the refusal of some growers to even pay laborers their entire reduced wages. According to the Beet Workers Association, an affiliate of the American Federation of Labor (AFL) made up primarily of field laborers, 41 claims for unpaid wages had been filed from the 1929 season totaling almost $7,300. Of course, that did not include the unpaid wages of laborers who chose not to file claims. While Great Western failed in its gamble to wait out the harvest a little longer, the company and its growers employed their power to pass off some of those losses to its workers.  

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In addition to providing direct aid and counsel to unpaid laborers, Mahony sought solutions that did not require any sort of dialogue with Great Western or its growers. As early as 1927, Mahony kept correspondence with the Mexican consulate and with Cleofas Calleros, a Mexican government representative stationed in the border town of El Paso. In at least one season, Mahony wrote Calleros to advise him to send fewer workers to the Piedmont since growers had planted fewer acres that year. Following the abuses of the 1929 season, and with

63 Ibid; Mahony to Linna K. Bressette, 6 January 1930, TFM Box 1, Folder 10; “The Beet Workers Association List of 1929 Claims,” TFM Box 3, Folder 3; “Beet Workers Given Praise for Loyalty,” TTL 17, No. 12 (December 1929), 545.
the onset of the Depression, Mahony used his connections to help Mexican nationals return permanently to Mexico. Though he did not admit to any policy of warning Mexican nationals against working for Great Western, Mahony admitted privately that he hoped fewer would come in 1930. If the labor pool were to shrink, he claimed, “…it will be about the quickest way to improve conditions.” It was clear, however, that others were warning Mexican nationals not to accept beet contracts as a result of Mahony’s influence. The Spanish-language magazine, *La Prensa* published an abridged version of his May 1929 speech. Great Western’s labor commissioner, C.V. Maddux, cited it as a serious threat to attracting the labor of Mexican nationals.\(^{64}\)

Maddux, who had ceased ignoring Mahony long before that *La Prensa* article, had begun to actively respond to claims of oppressive conditions in the beet fields. When Mahony stated that beet-workers’ families were only making $600 annually, Maddux countered that Mahony failed to take into account additional wages and that, in either case, his estimates were low. Maddux claimed that families earned $850 annually in addition to receiving free housing during the beet season and free transportation for those coming from outside the area. Disputing the idea that these wages were far below what Mahony claimed was a living wage, Maddux instead blamed racial characteristics of Mexicans while implying that Great Western was making steady progress on their behalf. In a 1928 speech given at the First City Conference on Denver’s Social Problems, Maddux stated that Mexicans seemed incapable of dealing with periods of distress without outside aid and that they needed to learn to “save for a rainy day.” He implied that this learned characteristic of Mexicans explained why, despite the fact that they were only 10% of the city’s population and only lived there part of the year, they consumed 16% of its fund for the

\(^{64}\) Maddux to Mahony, 15 April 1930, Mahony to Maddux, 20 April 1930, TFM Box 1, Folder 10; Mahony to Bresette.
Maddux explained that Great Western had been proactive by working with growers to provide better housing for laborers and by supporting the construction of *colonias* in most beet districts. He claimed that Great Western’s attempts to improve conditions – including the *colonias* - resulted in more laborers and their families remaining on the Piedmont year-round, stating that their numbers had increased by a factor of four from 1922-1928.\(^{65}\)

As Great Western’s head of recruitment, Maddux hoped to dull the impact of the publicity surrounding conditions in the beet fields, but his fears betrayed the company’s dependence on Mexican labor. Approximately 75% of the company’s labor force originated in Mexico or the American Southwest. Though Great Western occasionally argued that they could be replaced, its efforts to import a massive workforce, convince growers to treat them well, and build *colonias* suggests that, without this cheap labor force, the entire industry on the Piedmont would have crumbled. Public arguments between Maddux and Mahony illustrated why it was crucial for Great Western to control the labor narrative. As reports of abuses circulated into areas where the sugar company recruited its workforce, the quality and quantity of laborers it was able to procure suffered. Further, as articles and reports - both local and nationwide - exposed injustices in the beet fields, Great Western found itself facing public pressure to change its practices.

Great Western Sugar and the Mexican Welfare Committee were not the only organizations that claimed to accurately represent conditions for Mexican beet workers. During the late 1920s, conditions for beet workers combined with growing worker solidarity to produce union activism. The catalyst was a general strike in the Colorado coal fields in 1927. Led

\(^{65}\) Thomas Mahony, “Report of Addresses Given at The First City Conference on Denver’s Social Problems, June 6-8, 1928 Under Auspices of General Council of The Denver Community Chest, Denver, Colorado,” 6-8 June 1928, TFM Box 2, Folder 2.
primarily by the radical union, Industrial Workers of the World (I.W.W.), some of the miners out on strike in Northern Colorado were Mexicans who possessed ties to sugar beet laborers. It was common for beet workers to seek employment in the region’s mines during the winter. I.W.W. pleas for beet worker help largely fell on deaf ears during the fall of 1927 amidst the sugar beet harvest. However, during the ensuing winter, as food and fuel dwindled in the colonias, some beet workers asked the I.W.W. to send organizers into their communities. By the end of January, 1928, the I.W.W. claimed to have founded fourteen local chapters on the Piedmont, boasting 1,700 members. These efforts caught the attention of the American Federation of Labor (A.F.L.) which sent organizer Clementino Idar into the beet fields of Colorado, Wyoming, and Nebraska. Under the banner of the Beet Workers Association, Idar was able to organize over 10,000 workers within a year. Though the A.F.L. officially controlled the organization, it contained many I.W.W. sympathizers as well as socialists, communists, and members of Mexican-nationalist factions. The Beet Workers Association negotiated for better terms of employment with growers and Great Western, and initiated actions against growers who failed to pay contracted wages to beet workers. The union also facilitated the creation of mutualistas which provided support services for the families of beet workers. Though mildly successful, the Beetworkers Association fell apart in 1929. In that year, a dispute between growers and Great Western led to a 50% reduction in acreage, resulting in an oversupply of labor. The union also struggled financially as unemployed workers could not pay union dues, and the aforementioned harsh conditions during harvest that year reduced wages even further. During the ensuing winter, union organizers provided some aid to beet laborers, but they were further hampered in their efforts by the unfolding depression.  

The activism of beet workers in the late 1920s complicated the efforts of Thomas Mahony and the Mexican Welfare Committee. Mahony lent qualified support to unions. He believed that they were a corrective to the abuses of industrial capitalism since unions fought to alleviate oppressive living and working conditions and offered some of the best opportunities for laborers to gain a living wage. But Mahony feared the radicalism of the I.W.W. and other socialist-inspired unions which sought to enable workers to control the means of industrial production. He thought that radical union leaders were looking for opportunities to exploit abuses in the fields to win laborers to what he felt was a morally bankrupt agenda. As a lay leader in the Catholic Church, Mahony argued that radicalism was synonymous with “irreligion.” Believing that socialism was rampant within mutualistas, he called them “anti-Catholic, anti-clergy, against capitalism.” Mahony also feared that “Reds” were deliberately migrating to the Piedmont from Mexico in the wake of a socialist-inspired Mexican Revolution to support a radical agenda. Mahony’s work during the period of I.W.W. organizing in 1928 elucidated his fears. According to a calendar of his activities for the Mexican Welfare Committee from January through March of 1928, Mahony participated in at least fifteen meetings that explicitly discusses the influence of the “I.W.W…Reds,” and “Communism.” Viewing what he believed was unbridgeable divide between radical unionism and Catholicism, at one point Mahony reportedly told a groups of radicals from Mexico that “the Mexicans are our people and under our protection, and we would not stand for any unfair treatment.” At the same time though, Mahony refrained from calling out the names of any unions other than the overtly radical I.W.W., knowing that many unionists within the Beeworkers Association were Catholic, and cleaved closely to Mahony’s living wage dogma. Mahony inspired activism but he could not control its

protagonists, nor its direction. This would become even more difficult during the 1930s, as a severe economic depression set in. Mahony believed that “conditions, not agitators, make radicals.” Conditions were about to get much worse.\textsuperscript{67}

During the early 1930s, the harsh economic realities of the Depression landed hard on beet workers. In crises, those at the fringes of society suffer the most. On the Piedmont, beet laborers possessed little or no savings to weather financial storms. In addition, their relative lack of power enabled those in higher positions to place heavier burdens on them, thus offsetting their own burdens. The new tariff provides a starting point to understand this truth. In 1930, the first full year of the Depression, overall consumption of sugar dropped in the United States for the first time in several years, and the wholesale price of sugar dropped to less than 3 cents per pound, its lowest in over two decades. Beet sugar industry leaders clamored for and received a tariff increase of almost 12\% on imported sugar. With the costs of farm products in free fall, the wall of protection against foreign sugar – primarily from Cuba – enticed Piedmont growers to continue to plant large beet crops. While prices for farm products nationwide dropped an average of 60\% from 1929-1933, prices for sugar beets fell a modest 30\% due to these restrictions on Cuban imports. It might be expected that laborers in the beet fields experienced a proportional drop in wages. Statistics do not bear that out. While in 1929 Mahony and Maddux disagreed over whether laboring families earned $600 or $850 annually, reports from the Colorado State Industrial Commission in 1931 show that, just two years into the Depression, a fully employed family made less than $300 annually. The chief investigator for the Commission, J.R. Ruperson, equated those wages to “chattel slavery.” The \textit{Colorado Labor Advocate} stated that wages in 1933 had dropped to $120-$130 annually when considering that many laborers

\textsuperscript{67}“Desk Memorandum: Work Mexican Welfare Committee, 1928”; Mahony, “Wages of Unskilled Workers.”
were not fully employed. Using the term “industrial slavery” to describe the conditions in the beet fields, its author contrasted the remuneration with the fact that Great Western was still paying dividends of 7% on its common stock that year. Offering another perspective to view the disproportionate wage drop, Mahony compared the tariff benefits received by Great Western with the wages paid out to workers. He stated, “…the tariff on last year’s production of sugar is more by several million dollars than the total amount paid the Colorado farmers for beets, the 28,000 field hands for their labor and the 5,500 or so factory workers…all taken together.”

Suggesting that this was the intention from the start, Senator Reed Smoot of Utah, one of the authors of the new tariff and a representative from another state with a sizable beet sugar industry, stated in tariff hearings that the beet sugar industry “will not have to pay a dollar more for Mexican labor than in the past.” The high tariff offered the beet sugar industry protection from the worst storms of those early Depression years, while their laborers bore the full brunt of its economic fury.68

The tariff issue was one of several examples of how industrial agriculture externalized the costs of its labor force. In economic terms, externalization refers to passing off the costs of doing business to the public, or to the environment.69 In this case, the beet sugar industry rallied behind a high tariff. The tariff limited foreign competition, thereby keeping prices high enough to do business, even during the Depression. The costs of the tariff were externalized to the

68 “Labor Conditions are Assailed in Northern Colorado,” Denver Post, 5 September 1931; "Slavery Conditions in Beet Fields Reported to State,” Colorado Labor Advocate, 25 May 1933; Congress, Senate, Smoot Hawley Tariff Debates, 71st Cong., Congressional Record, (15 January 1930): 1700; Mahony to Edward Costigan, 22 February 1931, TFM Box 1, Folder 10.
69 While the term externalization has been most commonly used in discussions of late-twentieth century capitalism, it is fair to use that term here since Great Western Sugar was quite conscious that depressing wages while advocating high sugar tariffs was passing the costs of production and labor on to local, state, and federal agencies, as well as onto taxpayers. Historians Bart Elmore and Richard Tucker both address how industry has passed along the costs of doing business to taxpayers and the environment. See Richard P. Tucker, Insatiable Appetite: The United States and the Ecological Degradation of the Tropical World, Concise rev. ed, Exploring World History (Lanham: Rowman & Littlefield Publishers, 2007), 7–42; Elmore, Citizen Coke.
consumer, who paid higher prices for sugar, but they were also passed along to beet workers, whose wages were decimated to support the solvency of companies like Great Western. The company and its growers had been externalizing the costs of doing business almost from day one. Local school systems invested time and energy to solve the crisis of school attendance created by Great Western’s contract labor system that kept children in the fields during the school year. Costs were further externalized since the poor education many of them received resulted in a less educated society. The costs of the sugar beet industry were also transferred to local governments and private charities who were confronted with a mass of humanity that struggled to find adequate housing and make their beet wages last through the winter.

As the Depression gripped the Piedmont, beet workers needed public assistance more than ever before, at a time when social services were strained to their breaking point. This was not entirely new. Most counties on the Piedmont maintained a small “poor fund” that was used to provide a pittance for beet families to make it through the winter, with larger cities such as Denver and Pueblo, where sizable numbers of Mexicans lived during the off-season, providing more public assistance per capita. Various private agencies such as Colorado Catholic Charities also provided health clinics, self-improvement classes, food, and monetary aid. The scale of the need increased exponentially during the 1930s as wages plummeted and unemployment spread. Growers sought to gain some insurance against low sugar beet prices by crafting contracts that paid hand laborers a percentage instead of by the acre. Under this system, growers received their beet checks from Great Western, and then laborers were given a percentage of that check – typically 20-25%. Growers also resorted to paying by the job. So, instead of being

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70 For example, in 1924, Weld County doled out over $5,000. In 1930, Colorado Catholic Charities spent over $600,000 in aid for Mexicans. See Maddux to Mahony, 11 March 1925, TFM Box 1, Folder 5; Mahony to Maddux, 29 March 1931, TFM Box 1, Folder 10.
hired on for an entire season, growers hired some hand laborers only for thinning, cultivating, or harvesting. Not only did this have the net effect of lowering wages, but it created considerable insecurity for workers and their families, as some types of contracts forced laborers to survive for an entire season before receiving wages. Some of that insecurity was externalized to local and especially federal relief agencies.\(^\text{71}\)

Several examples demonstrate that movement toward greater reliance on outside help. In 1933, the Federal Children’s Bureau compiled several case studies of families in the beet fields who wintered in the Denver and Pueblo areas, most of whom worked for Great Western Sugar. Frank M. was one of Great Western’s favored workers and the company offered him the chance to buy a small lot and build an inexpensive house within a colonia. He lived in a two-room house he built for his family of seven. Owing to falling wages, he made no house payments after 1931. He was able to do some side work by cultivating other crops, but he began to receive federal aid in 1932 for four months out of the year. In 1933, he had a percentage contract that did not pay him until the end of the season, requiring him to take in federal relief at the rate of $12 per month. Manual G. had a family of seven also and was fortunate to live rent free in a house owned by Adams County. In 1931, he worked ten acres at $10 per acre and received supplemental work picking beans and tomatoes, but his money ran out in January, requiring him to apply for federal aid. He could not get a beet contract in 1932, so he picked beans again, relying on partial federal aid. He received a 30-acre contract in 1933, and he contracted to buy a truck for $200, hoping to gain employment as a hauler in the off-season.\(^\text{72}\)

\(^{71}\) Katherine Lenroot, “Statement of Economic Conditions and Child Labor in Families Employed in the Beet Fields of Colorado,” 11 August 1933, TFM Box 2, Folder 2.

\(^{72}\) The size of Manual’s contract implies a great deal about child labor. The average adult, beet worker could handle 10 acres in a season. So, his 1933 contract presumes that his wife and children would spend considerable time in the beet fields.
Stories of struggle like these help to explain the increasingly radical direction of beet labor unions in the early 1930s. In 1932, beet workers on the Piedmont formed the United Front Committee of Agricultural Workers, largely out of the defunct Beet Workers Association. The United Front was a subsidiary of the communist-led Trade Union League (TUUL). According to Dennis Nodín Valdés, the origins of TUUL’s presence may have originated when several Colorado beet workers attended TUUL’s first meeting in Ohio in 1929. In May, 1932, after most migrant laborers arrived on the Piedmont, and before the start of thinning season, the United Front called a general strike of all beet workers on the Piedmont to protest wage reductions by growers. Between 1929 and 1932, rates per acre had dropped by over half. Of course, as the above stories show, wage cuts were only a part of the story, since many beet workers were only able to obtain work for part of the season, if at all. An estimated 18,000 workers refused to take up their hoes and shovels that spring in response. Though large, the general strike was quickly quelled as growers and Great Western used several tools to break union resolve. The foremost among them consisted of what Mahony referred to as “hunger pressure.” Median wages for beet workers in the early 1930s had to be supplemented by public relief for workers to survive. Great Western and its growers employed their influence with local relief boards to remove striking workers from their relief rolls. In Weld County, sheriffs patrolled farms to force workers into the fields and jail those who refused. Since those in jail were the most recalcitrant they were targeted for deportation. In fact, between 1930 and 1935, local sheriffs, relief agencies, and the Immigration and Naturalization Service colluded to deport 20,000 Mexicans living in Colorado.\footnote{Mae Ngai has argued that immigration law during the period criminalized Mexicans who were viewed by society as unifit and morally outside of societal norms. This made their presence in the U.S. subject to whims and individual judgments, such as occurred on the Piedmont during the 1930s. See Mae M. Ngai, \textit{Impossible Subjects:}}
the state, it is likely that at least half of those deported were beet workers from the Piedmont.
The strike also failed due to overreach. Communist labor advocates from TUUL and International Labor Defense (ILD) had pledged financial and legal support for the strikers that largely did not surface.  

Finally, with a Depression-induced labor surplus, growers simply had enough workers at their disposal to carry on cultivation. So, the 1932 United Front strike failed, and the union quickly disintegrated.

Concerns over the flagging state of American agriculture during the Depression motivated the administration of newly elected president Franklin Roosevelt to take action in 1933. Consequently, new secretary of Agriculture, Henry Wallace, instructed the newly formed Sugar Stabilization Committee of the Department of Agriculture to determine how wages and payments within the beet sugar industry might be regulated. As part of its investigation, it took testimony from sugar beet laborers. Leo Rodriguez was one of them. Rodriguez had done hand labor in sugar beets since 1903. He worked on the Piedmont during the Depression, but he lived in Pueblo with his family of nine during the winter. He had formerly labored in one of Pueblo’s steel mills in the winter, but the steel mill limited operations at the same time beet wages plummeted, and Rodriguez went on relief. He stated that all of his neighbors were beet workers, and all but one of them were on relief. For a month his family of nine received “…one-hundred pounds of flour, a nine-dollar order of groceries, and a half-ton of coal.” As if to add insult to

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hardship, Rodriguez testified to personal knowledge of fourteen beet laborers who had been cheated by growers on their wages in 1932.\textsuperscript{76}

In 1933, Leo Rodriguez was one among many interested parties testifying before the Sugar Stabilization Committee. In March 1933, just days into the Roosevelt Administration, Congress passed the Agricultural Adjustment Act (AAA). The landmark legislation created quotas for seven basic farm commodities. Seeking to bring production in line with consumption, the federal government issued farmers checks based on acres they took out of production.\textsuperscript{77}

Sugar presented a more complicated crisis, but one that New Dealers hoped to address. High tariffs and falling sugar prices decimated the economy of Cuba, America’s principal sugar supplier, while conditions in the beet and cane fields of the United States declined. Federal legislators sought to stabilize production, provide livable wages for growers and laborers, steady profits for sugar companies, and clear quotas for domestic and imported sugar. Rodriguez hoped his testimony would convince Congress to pass legislation leading to substantial improvements in the wages and working conditions of beet laborers. In 1933, Rodriguez was able to tell his story in part because the Federal Children’s Bureau and the National Child Labor Committee paid for much of his trip to Washington. In early 1934, he supported a petition from the Colorado Beet Laborers Committee to Secretary Wallace. In addition to corroborating Rodriguez’s statement on wages and relief, the petition stated that beet workers and their entire families were being pushed into a state of “permanent peonage,” and that the Mountain States Beet Growers Association had taken advantage of the naiveté and desperation of Mexican

\textsuperscript{76} Lenroot, “Statement of Economic Conditions…”; “Statement of Leo Rodriguez before the Sugar Stabilization Committee,” 10 August 1933, TFM Box 1, Folder 14.

\textsuperscript{77} Those basic commodities were corn, wheat, milk, cotton, rice, peanuts, and tobacco.
workers to force them to sign oppressive contracts. Finally, they complained that the local relief agencies responsible for administering federal aid were in collusion with Great Western and its growers to force Mexicans into the fields whenever their labor was needed.

The final version of the Jones-Costigan Amendment to the Agricultural Adjustment Act, passed in 1934, contained some provisions destined to improve conditions in the beet fields, but its initial administration demonstrated a lack of concern for the wages of beet workers. The Jones-Costigan Amendment added sugar to the list of agricultural commodities in the Agricultural Adjustment Act, and set a voluntary production quota of 1.55 million tons of beet sugar that could be refined in the United States, a quota which the entire industry agreed on. Based on acreages in 1934, growers were scheduled to receive $10 million in federal payouts for reducing their beet production. To receive payouts, growers agreed that no children under the age of fourteen would be employed, and that those between 14 and 16 would be required to obtain work permits and could not work more than 8 hours per day. As part of the Jones-Costigan Amendment, the Secretary of Agriculture set annual wages and time tables of payment for laborers in the beet fields, requiring growers to certify that they had paid their workers before receiving their federal refunds. Growers were also required to provide “a habitable house, suitable water near at hand for drinking and domestic purposes, a suitable garden plot…and transportation…to the farm prior to the beginning of the hand labor operations and from the farm…upon completion of the work contracted.”

78Beginning in 1927, there were several attempts to form beet workers unions. They petitioned for higher wages, briefly went on strike in 1932, and picketed at some of Great Western’s recruiting centers in the Southwest. Their actions were largely unsuccessful due to discrimination, lack of unity, efforts by Great Western Sugar to thwart their efforts, and deportations in the mid-1930s. See Vargas, Labor Rights Are Civil Rights, 27–34, 70–76, and 148–150.

79Bressette to Mahony, 12 August 1933, TFM Box 1, Folder 14; “Colorado Beet Workers Committee to Henry A. Wallace,” 20 March 1934, TFM Box 1, Folder 15.

80U.S. Department of Agriculture, Office of Information, Press Service, “Sugar Contracts to Protect Labor; Growers’ Benefits to Total $10,000,000,” 3 July 1934 (Washington: Agricultural Adjustment Administration), TFM
The crafting and implementation of the Jones-Costigan Amendment emphasized the marginality of sugar beet laborers. Though Leo Rodriguez and the Colorado Beet Workers’ Committee petitioned Congress on behalf of labor, lobbyists for the beet and cane sugar industries and growers’ associations provided the vast majority of testimony. In fact, Fred Cummings, former head of the Mountain States’ Beet Growers Association and one of the largest growers on the Piedmont, represented the region in Congress during the Jones-Costigan debates. When the bill went into effect in May 1934, beet growers were immediately apprised of their allotted acreage, knew how much they would be paid per ton of beets, and could count on a check at the end of the season for unplanted acres. Laborers, on the other hand, possessed no such security. As late as the end of August, Wallace had not published wage rates, so most laborers had not been paid a dime. In lieu of this, many growers attempted to foist the same percentage contract on workers that they had used in previous years, some claiming that this was in fact the contract that had been approved by the Secretary of Agriculture. With reduced acreage, and no guaranteed contract, some beet workers hoped that more federal aid would be extended to them.\(^{81}\)

It was not. As much as 91% of federal aid administered in Colorado during any given Depression year after 1932 came from the Works Progress Administration (WPA) of the federal government, headed by Harry Hopkins. The WPA relied on labor statistics from states to make aid determinations and to fund federal projects that gave jobs to unemployed workers. Counties, however, administered direct aid. On the Piedmont, Great Western’s representative and growers dominated the county boards that distributed aid. They used that influence to remove beet

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\(^{81}\) Ibid; Colorado Beet Workers Committee to Wallace, 22 August 1934, TFM Box 1, Folder 15.
laborers from county relief rolls in June, at thinning season, and again in August as preparations for the harvest began. In 1934, beet laborers were removed from relief rolls and forced into the beet fields without knowing when, or if they would be paid, employing a tactic Mahony referred to as “hunger pressure methods.”

Approaches to aid and work ran the spectrum from mildly discriminatory to oppressive. Though Great Western provided a list of laborers to WPA boards, when it was time to cull its lists, some Piedmont counties simply removed everyone with a Hispanic surname from their rolls. Most of those beet workers remained on the Piedmont during the growing season. However, Great Western took advantage of the sudden influx of labor caused by the culling of the relief rolls to place some of its workers into the beet fields of Nebraska and Wyoming, where labor shortages existed. In Weld County in 1934, beet workers who applied for federal relief had to submit a special “Application for Federal Relief” that had to be signed by a Great Western field man before they could receive aid. It asked questions regarding whether they had conserved food, whether they had gardened successfully, and what type of clothing they possessed. In 1937, beet workers had to submit a pay statement from their grower, turn in a driver’s license and car plates, and give an accounting of money spent during the previous year. Though these questions could have been used to determine family needs, in essence the application implied that beet workers – primarily Mexicans – were not thrifty with their

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82 E.L. Kirkpatrick, “Statement Presented at Hearing on Proposed Marketing Agreement for the Stabilization of Sugar,” 10 August 1933 (Washington: Federal Emergency Relief Administration), TFM Box 1, Folder 14; Mahony to Paul Taylor, 14 July 1934, TFM Box 1, Folder 15; Harry Hopkins to Edwin Johnson, 5 November 1934, TFM Box 1, Folder 15; “Slash in State WPA Workers is Underway,” Rocky Mountain News, 13 March 1936.

83 Those labor shortages existed primarily because Mexicans had either migrated to the Southwest or Mexico, or were forcibly repatriated to Mexico in one of the largest mass deportations in American history. On that repatriation, see Francisco E. Balderrama and Raymond Rodriguez, Decade of Betrayal: Mexican Repatriation in the 1930s, Rev. ed. (Albuquerque: University of New Mexico Press, 2006).
resources, and that their employer, Great Western, could require frugality as a precondition for federal aid.\textsuperscript{84}

Great Western was only interested in denying aid to beet workers during thinning, cultivation and harvest, since WPA relief subsidized its operations during the remainder of the year. Into the 1930s, the company spent several hundred thousand dollars annually to transport laborers from the Southwest and Mexico to and from the labor fields. The prospect of federal relief during the winter months held some of its workers on the Piedmont, or at least within the state. Consequently, the company saved money that might otherwise have been spent on recruiting and transportation. Further, according to John Gross, Secretary of the Colorado Federation of Labor, immediately after counties removed Mexicans from their relief rolls, wages in the beet fields dropped $.10 -.15 per hour since laborers had to compete for jobs. Moreover, despite claims to the contrary, Great Western continued to recruit laborers from outside its factory districts. With a critical mass of workers held in place partly due to federal relief, Great Western was able to externalize some of its costs of production to the federal government. Finally, Great Western’s pattern of continued labor recruitment gave the company more latitude to deter union activity since it could replace suspected radicals with a pool of laborers less likely to stir up trouble in the beet fields.\textsuperscript{85}

The Jones-Costigan Amendment and discrimination in the administration of relief propelled a fresh wave of union activity. While the Jones-Costigan Act served to increase wages for beet laborers, its benefits were skewed to serve the interests of growers over laborers.

\textsuperscript{84} “Protesting Intimidation of Beet Workers on Relief,” January 1937, \textit{the Rural Worker}, TFM Box 2, Folder 20.

\textsuperscript{85} “Se Necesitan Trabajadores de Betabel Para Los Distritos de The Great Western Sugar Company,” TFM Box 3, Folder 3; Telegram from John Gross, Secretary of Colorado Federation of Labor to Harry Hopkins, 23 March 1936, TFM Box 2, Folder 20.
Though beet workers received higher wages for their work as a result of the act, there was no guarantee of employment. Growers, on the other hand, received annual government payments based on reduced acreage. To a limited extent, they benefitted by employing fewer laborers. By the end of 1935, two full seasons after the implementation of the Jones-Costigan Act, Colorado beet growers had collected $6.1 million in federal payments. This represented 40% of all AAA payments to Colorado farmers during those two years. While growers received hefty federal payouts, laborers relied even more heavily on the same federally sponsored relief that subjected them to indignity and potential deportation.86

It was in this context that beet workers formed the Colorado Conference of Beet Field and Agricultural Unions (CCBFAU) in 1935. Created from the remnants of former beet worker locals and affiliated with the A.F.L., the new union employed some tactics that diverged from those used previously. Since wage rates for laborers were published annually by the Secretary of Agriculture, the CCBFAU relied heavily on its AFL representatives to lobby in Washington for higher wages. For example, in 1937, the union lobbied for a wage rate of $23 per acre which would have returned wages to their 1929 levels. At the local level, the union proposed a contract that addressed perceived injustices in the relationship between laborers and growers. The contract stated that payments for all labor be made at the end of each operation – thinning, cultivation, and harvest – rather than at the end of the season. The contract also spelled out that, if growers hired additional laborers once the season started, they could not charge those wages against the beet worker who originally signed the contract. Workers also demanded that health officials verify that sanitation and water quality for workers living on grower property meet local health standards. Finally, and most importantly, the contract demanded that Great Western agree

to collective bargaining with a beet worker union representative during annual contract negotiations.\textsuperscript{87}

Unsatisfied with progress in 1937, Piedmont beet workers chose to align themselves with the more radical United Cannery, Agricultural, Packing, and Allied Workers of America (UCAPAWA), an affiliate of the Congress of Industrial Organizations (CIO). UCAPAWA locals on the Piedmont responded to Great Western’s threats of deportation and manipulation of the labor market by picketing recruitment centers in order to reduce the flow of laborers onto the Piedmont. The union also tried to place beet workers and advocates on boards that determined relief payments in the hopes of ending the practice of removing beet workers from relief rolls at the start of thinning season. At its height in 1938, UCAPAWA boasted as many as 20,000 beet workers, with 8,000 of them residing in Colorado. During the fall of 1938, UCAPAWA locals in Colorado threatened to “leave beets in the ground” if their proposed contract for the following year were not negotiated and agreed on. According to Valdés, those strikes were narrowly averted as a consequence of divisions within the ranks sowed by agents of Great Western Sugar. Failure in 1939 resulted in a decline in UCAPAWA ranks and by the end of that year only six union locals remained. By 1941 union activity in the Colorado beet fields had ceased.\textsuperscript{88}

There is no question that, beginning in 1935, when Secretary Wallace began to publish annual wage requirements for beet workers, conditions for laborers improved by a small degree. However, on the whole, life and work for beet laborers still resembled an abusive past more than a hopeful future. Wallace set 1935 wages at $19.50 per acre and $.75 for each ton harvested beyond twelve. Wallace also established wages for completing separate parts of the operation –


\textsuperscript{88} Ibid; “Transcript of Talks Made over Station KFKA, United Cannery, Agricultural, Packing, and Allied Workers of America, CIO,” 26 September 1938,” TFM Box 3, Folder 2.
thinning, cultivating, and harvesting. Federal law required growers to pay wages for thinning and cultivation upon completion, instead of withholding them until the end of the season. In addition, growers could not receive federal aid for unplanted acres each season until after they had paid their hand laborers. Overall, wage rates were almost double what workers were paid in 1933. Even with these guaranteed wages, some growers defrauded laborers of a portion of their wages by putting pressure on them to sign receipts stating that they had received payment.

According to Mahony, state and county agents acting for the Agricultural Adjustment Administration were loath to hear cases of wage fraud, and Great Western claimed no moral or legal responsibility to intervene. The new contracts also still allowed growers to hire additional hand labor and charge it against the account of the worker who originally contracted to do the season’s work. Though far fewer children who were under 10 worked in the fields, the majority of those 11 and older continued to labor in the fields. In part families could shirk regulations by claiming that their children were older, since growers, company officials, parents, and school authorities generally did little to suggest otherwise. The administration of welfare and relief remained in the hands of those connected with the beet sugar industry, perpetuating the stubborn assumption that Mexicans belonged in the fields. Poor housing for beet workers and their families persisted throughout the 1930s with over 70% of families cramming into houses that provided an average of 1.5 bedrooms for 6 people. Few homes were weatherproof, most were unsanitary, and at least one investigator in 1939 found that dysentery was common among workers as a result of poor sanitation. By contrast, from 1933 – 1938, Great Western paid out $44 million in dividends to its stockholders. Judged by Thomas Mahony’s standard of a living
wage – or almost any other standard for that matter – beet laborers remained on the margins of society while they continued to be the source of great wealth for the beet sugar industry.  

Beginning in the early 1940s, the number of laborers on the Piedmont began a long and steady decline, primarily due to the mechanization of the industry. While reducing the need for hand labor had always been a priority for Great Western and its growers, it was in the mid-1930s that the company formalized a policy to eliminate hand labor in the beet fields. This was in large part due to limitations on acreage set by the Jones-Costigan Amendment. With an annual ceiling on acreage, beet sugar companies such as Great Western could no longer profit by convincing more farmers to plant beets. So, companies focused on reducing costs per acre. Labor represented the highest of those costs. The beet sugar industry was joined in its efforts by U.S. Department of Agriculture researchers as well as scientists in the research stations of agricultural colleges such as Colorado Agricultural College, Michigan State, and the University of California at Davis. In the late 1930s, their efforts resulted in improved machinery for the thinning of beets. They developed various knives and cutters that reduced the time it took to cultivate the beet crop. Effective use of these devices required tractors, and by 1945, more than half of the growers on the Piedmont had replaced animal power with tractor power. Various phases of the harvest were mechanized during the period, beginning with mechanical pillers and loaders and progressing to machines that could top, loosen, and pull beets. In 1946, a collaborative group of state, federal, and company researchers designed a machine that could perform all of the harvest operations. Despite advances, thinning presented ongoing problems, but during the 1940s and 1950s, mechanical and biological advances produced seeds that minimized weeds and plant diseases.

and which were engineered for more effective thinning. All that remained in the 1950s for full mechanization of the industry was for growers to employ these advances during thinning season. In the meantime, Great Western replaced many of its remaining laborers with Braceros from Mexico, contracted to work during the thinning season, and then disappearing back into Mexico when their work was complete. By 1973, the entire industry was mechanized.90

Even in 1955, Great Western Sugar spoke of hand laborers as though they were already relics of the past. As the company prepared for its fiftieth anniversary celebration, Thomas Hornsby Ferril’s film, “The Great Western Story” was only one part of the festivities. In order to promote goodwill toward the company, E.L. Howe produced a “Survey of Promotional Possibilities In the Great Western Sugar Company’s Fiftieth Year.” The 18-page document provided a justification for celebrating the company’s history, and offered a list of 27 “Anniversary Proposals.” Howe was concerned that a rapidly urbanizing population in the region was unaware of the company’s operations and that the majority of the Piedmont’s journalists and media outlets had little connection with the sugar company. Arguing that Great Western had always been an “…intense source of local pride,” and that its history was “…colorful and deep rooted,” he displayed obvious pride in the company’s employees, its products, and the communities around which the beet sugar industry had been built on the Piedmont. Yet, in his efforts to re-craft Great Western’s story for public consumption, there was no mention of or even allusion to the field laborers who, until recently, dominated the physical landscape of the beet sugar industry.91

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91 E.L. Howe, “Survey of Promotional Possibilities…”
Howe’s promotion of Great Western presented more continuity with the past than revision of it. From the industry’s genesis on the Piedmont, Great Western, local boosters, academics, and farmers had willfully hidden the industry’s need to import laborers from society’s fringes. Though some public officials sympathized with the plight of beet workers, it was more convenient for Great Western, its growers, and most Piedmont residents to ignore their meagre wages, poor schooling, financial woes, and sub-standard housing. When reports of pitiable conditions surfaced through official reports or the advocacy of people such as Thomas Mahony, the response of growers, public officials, and Great Western executives was often to blame problems on presumed racial characteristics such as laziness or lack of thrift. Great Western, for its part, generally argued that, since laborers signed contracts with growers, the company bore no responsibility. In his attempts to celebrate Great Western’s past, Howe’s deliberate exclusion of beet field laborers mirrored the same marginalization of labor that had characterized the company’s fifty year history.

Historian Donald Worster has argued that good farming makes people healthier, strengthens community, and promotes a more just society.92 From the perspective of the hand laborer on the Colorado Piedmont, agriculture in the sugar beet fields did none of those things. The contract labor system compromised the physical health of workers through long hours of backbreaking, repetitive, and often dangerous labor, and housing that lacked sanitation and physical comfort. Sugar beet agriculture eroded communities since it demanded a seasonal labor force that locals were not willing to integrate into community social and economic life. Far from bridging racial and socioeconomic gaps, sugar beet agriculture widened the distance between

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social classes, casting its workers onto public relief rolls and relegating them to segregated neighborhoods. Neither did the beet sugar industry promote a more just society. As Thomas Mahony’s attempts to expose inequalities demonstrates, Great Western Sugar achieved astounding financial success during the period under analysis, much of it extracted from the workers who made that wealth possible.
Chapter 4: Sugar State: How State-Sponsored Science Transformed an Industry

At the dawn of the twentieth century, sugar was everywhere in America. It was in everything: soft drinks, baked goods, ice cream, and was the most important preservative in a host of canned goods. As a relatively inexpensive product, sugar packed sweetness, calories, and energy into a compact package.\(^1\) Recognizing its value in American life, the federal government took a keen interest in developing a domestic sugar industry. Since few locales existed in the United States that possessed the climactic and soil requirements for growing sugar cane, state agencies prioritized sugar beets, a sucrose-laden vegetable adapted to temperate zones. As early as 1883, one of those agencies, the United States Department of Agriculture (USDA) sponsored research in beet cultivation, identifying regions where they could be grown, and gathering information on how to build and operate factories to extract sucrose from beets. Using federal monies, land grant colleges performed experiments aimed at demonstrating to farmers and industrialists that sugar beet agriculture could succeed and turn heavy profits for growers and companies alike.\(^2\) In addition, Congress legislated high tariff walls on imported sugar.\(^3\) Those two factors – federally-sponsored research and tariff protection – were enough to tempt industrialists and farmers to invest their land and capital in a fledgling industry. As Americans consumed sugar in ever increasing quantities at the turn of the century, the state hoped that domestic sugar could satisfy some of that sweet tooth.

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\(^3\) The 1897 Dingley Tariff set a rate of 1.685 cents per pound on raw sugar, an increase of 18%.
Growing American consumption, imperialism, and support for domestic agriculture explain why the state placed such value on an easily imported commodity such as sugar. Between 1880 and 1900, sugar consumption in the United States rose from 1.4 to 2.3 million tons, making it the world’s largest consumer. Most of that sugar was imported from the cane fields of the tropics where imperialism and plantation agriculture created oppressive conditions for workers. American industrialists and local beet sugar boosters argued that beet sugar could wash the stain of exploitation from the hands of consumers by enabling them to purchase a domestic sweetener cultivated by the hands of hard-working American farmers, while delivering a thriving new industry and healthy agricultural communities to the rural regions of the United States. Germany was the model beet sugar promoters most often put forward. That nation had offered scientific support and high tariffs to develop an industry that produced more sugar than all of the cane fields of the Caribbean combined, supplying its entire domestic demand.

Germany’s example of state-supported sugar independence offered a template for American industrialists, beet boosters, and the state. According to Charles Saylor, the USDA’s primary sugar beet investigator in 1901, sugar independence would “eliminate the foreign grower as a factor in the supply of our daily wants, our business methods, and the emergencies of war,” at the same time that it opened up new opportunities for farmers and manufacturers. Sugar beet promoters, entrepreneurs, and the USDA agreed that a thriving beet sugar industry was an unqualified national good requiring federal support.

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4 Lippert S Ellis et al., The Tariff on Sugar (Freeport, Ill.: Rawleigh Foundation, 1933), 45.
During the first half of the twentieth century, the state and the beet sugar industry established a relationship that evolved from support to cooperation to mutual dependency. Prior to World War I, USDA scientists prioritized research aimed at establishing the beet sugar industry and fostering its growth. As federal scientists conducted research at the behest of industry, beet investigators at all levels – the federal government, industry scientists, and researchers from agricultural colleges – developed professional and personal relationships that enabled them to move seamlessly between state and industry. World War I accentuated the value of beet sugar producing regions such as Colorado, as growing demand and reduced global supply convinced the wartime U.S. Food Administration to fix prices for growers and manufacturers alike. The disruptions of war highlighted the nation’s dependence on imported sugar, brought volatility into the sugar market – despite wartime efforts to combat market insecurity – and exposed the inefficiencies and technological weaknesses of the domestic beet sugar industry. Bolstered by growing Congressional appropriations and higher protective tariffs following the war, state scientists concocted a host of projects to streamline production and bring new technologies into the fields. In the drive to make the beet sugar industry more efficient, the lines between state-sponsored scientist and corporate researcher blurred, and eventually disappeared. By mid-century, most of the goals shared by state-sponsored scientists and the beet sugar industry were achieved. Still, the relationship between the two was more entrenched than ever. The same processes meant to make the beet sugar industry more productive – and thereby independent of the need for state-sponsored aid – resulted in state sugar interests becoming indistinguishable from those of the industry it subsidized.
My examination of federally-sponsored science in the beet sugar industry demonstrates that divisions within the state were neither monolithic nor static. During the initial decade of the twentieth century, beet sugar researchers employed by the federal government were found in a handful of divisions within the USDA. Their work was relatively unhindered by Congress or other divisions of the federal government since sugar beet agriculture was so specialized that researchers could easily lay claim to an expertise not available within other divisions of the federal bureaucracy. Thus, state-sponsored science during that period refers to a well-defined set of actors carrying out a directive to develop a domestic beet sugar industry with relative impunity. These researchers were not without peers, though. Those were generally found within the beet sugar industry and at agricultural colleges. So, it made sense that sugar beet researchers in the USDA were drawn to industry scientists and researchers at land grant colleges and further, that many of the their projects were industry-driven. This did not mean that the state was at the beck and call of individual manufacturers. Rather, it became both an appendage and transmission line. State-sponsored scientists were less interested in solving the problems of a single company than they were in broadcasting their findings to a broad spectrum of sugar producers. But, just as any body part requires a living host to survive, so state attachment to the beet sugar industry required a thriving host whose survival required the appendage. The state bureaucracy that arose around the beet sugar industry came to depend on that industry’s survival for its own.

Though Piedmont farming and irrigation practices at the turn of the century placed it at the forefront of Western agriculture, it was one of many regions in the arid West where sugar

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7 ‘Divisions’ is used to refer to the various departments, agencies, offices, and divisions within the federal government. Where a specific division is referred to the specific title will be used (agency, department, office, division).

beets could be grown. With the exception of the low deserts of the Southwest, the rainy Pacific Coast, and the high mountains, most of the West shares broadly similar climatic conditions with the Piedmont. In addition, at the turn of the century, many of the rivers that ran through the arid West could be tapped to provide the irrigation necessary to grow sugar beets. Finally, though sugar beets require careful cultivation, they thrive in the broad spectrum of soils found throughout the West. Thus, Piedmont sugar beet agriculture was portable, enabling scientists to employ their beet research throughout the West. Further, as the beet sugar industry expanded through the first half of the twentieth century – and state-sponsored research with it – knowledge gained in one place was easily transmitted to another. Consequently, the Piedmont opens a window to view how state-sponsored science and industrial agriculture formed relationships during an industry’s infancy, and how their growing interactions spun webs of interdependency, erasing the lines that separated industry and the state.

Seeds of Industry/State Cooperation: The Division of Sugar Plant Investigations

State-sponsored science aligned itself with industrial agricultural on the Piedmont from its origins. In 1901, Great Western Sugar built the first of its many factories in the region. That same year, the Division of Sugar Plant Investigations (SPI), an agency within the Bureau of Plant Investigations (BPI) was formed to support the beet and cane sugar industries. Headed by

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9 Other states with large beet sugar industries included Michigan, California, Utah, Idaho, Nebraska, Montana, Ohio, and Washington. Studies that focus on some of these other region include Mapes; Matthew C. Godfrey, Religion, Politics, and Sugar: The Mormon Church, the Federal Government, and the Utah-Idaho Sugar Company, 1907-1921 (Logan, Utah: Utah State University Press, 2007).

10 The USDA’s Department of Chemistry and several agricultural colleges conducted beet sugar research prior to 1903. See Dupree, Science in the Federal Government, 176-180; Colorado Agricultural Bulletins 7 (1889), 11 (1890), 14 (1891), 23 (1893), 43 (1898), and 51 (1899).

plant pathologist, Charles Townsend, scientists at SPI were guided by a broad federal mandate to enlarge domestic sugar supply by conducting research that would increase productivity and efficiency for existing manufacturers, while encouraging industry expansion to new regions. The fact that SPI, a division within the USDA targeted manufacturers and not farmers, points to one of the peculiar, yet overlooked aspects of the beet sugar industry. Unlike other market crops such as corn and potatoes, sugar beets required factory processing to extract a usable product for the market. Further, it was necessary to raise large sums of capital to build factories, purchase machinery, and hire the labor who could perform the physical acts necessary to transform a rather innocuous vegetable into sugar. Entrepreneurs that raised such capital generally required hundreds of farmers to sign contracts pledging to plant several thousand acres in beets annually before they would consider investing. Thus, given the choice between collaborating with hundreds of growers farming limited acreage and talking with industry officials representing those same growers, SPI researchers chose the latter. SPI did not evolve to serve industrial agriculture. It was an implied mandate.

In its initial years, SPI researchers, including Townsend, recognized that its research agenda was dependent on industry scientists with more experience. Seeds provide a poignant example. Motivated by the desire to increase sugar production, and concerned with the almost total reliance sugar beet farmers had on imported seed, SPI researchers sent out questionnaires aimed at discovering which imported seeds proved most successful on American soils in an effort to jumpstart its own seed research. Each sugar company was asked for a list of every variety of imported beet seed used on its growers’ land, correlated with the sugar beet yields and

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12 The USDA’s longstanding emphasis on seed development and distribution is explained in Dupree, *Science in the Federal Government*, 157-183.
percentages of sugar produced by each seed variety. To encourage cooperation, letters attached
to the questionnaires emphasized that complete responses would lead to better seed selection,
pointing out that increasing the average sugar content of beets by just one percent would result in
thousands of dollars of profit for each factory with virtually no increase in manufacturing cost.\footnote{13}

The responses from sugar beet companies revealed several inefficiencies that hindered
SPI research goals. Great Western Sugar, for example, submitted tables from its growers
showing sugar beet acres planted and yields for several consecutive years. But, growers
generally did not provide the sort of statistics that explained why some years and certain fields
were more productive than another. One particular grower, William Stanley of Eaton,
meticulously completed a chart documenting acres planted in beets each year, tons harvested,
payoffs by Great Western, and net profits. Though Stanley could detail which varieties of seeds
he planted, he could not correlate them with yields or sugar content.\footnote{14} Like other growers,
Stanley varied his seeds from one year to the next, and even planted different types within a
given year. As with successful farmers everywhere, he experimented with a variety of seeds in
the hopes of finding those best adapted to his farm conditions. Great Western also bore some
responsibility for this spotty tabulation. The company was responsible for purchasing seeds - the
majority being from various seed houses in Germany - and then selling them at cost to their
growers. But, Great Western made no attempt at that point to track them from point of sale to
harvest. From point of seed sale through harvest, responsibility lay with the grower. In pointing

\footnote{13} Charles Townsend to Amalgamated Sugar, 6 January 1905, Records of the Division of Sugar Plant
Investigations (hereafter SPI), Records of the United States Department of Agriculture, Record Group 54, National
Archives Building II, College Park, Maryland (hereafter RG 54), Townsend Office Files, Box 1, folder A.;
Townsend, “Testing Comparative Merits of American and Foreign Grown Varieties of Sugar Beet Seed,” SPI,
Miscellaneous Reports, 1903-1909, Box 1, RG 54.

\footnote{14} Statement of Beets Grown by William Stanley for Great Western Sugar, 1902-1911, SPI, Townsend Office
Files, Box 1, folder M, RG 54.
out these complications while also trying to be helpful, Great Western Secretary W.A. Dixon, included a pound of refined sugar from each of its factories along with the company’s incomplete questionnaires from 1904.\textsuperscript{15} Whether the sugar was intended as advertising for Great Western’s product, or perhaps Dixon hoped that SPI researchers could gain useful scientific information from the exchange – or both – is cloudy. What is clear is that SPI’s attempts at data-gathering required a more hands-on approach than questionnaires offered.

For SPI, that direct approach involved developing its own seed research, in growers’ fields and at the experiment stations offered by industry and agricultural colleges. With the goal of materially increasing the sugar yield locked in each seed, SPI conducted research at experiment stations in Colorado, New York, Michigan, Utah, and Washington, as well as on the USDA’s own land in Arlington, Virginia. Great Western placed SPI researchers into contact with large growers who offered some of their land for seed experiments. The results, according to Townsend and other SPI researchers, was that by 1908, they had already achieved sugar yields on a commercial basis higher than those of the major European growers.\textsuperscript{16}

Then why did the beet sugar industry remain reliant on imported seed? The answers were found in science and the free market. An initial sugar beet seed crop required two years to mature. The roots are formed in the first year, and left in storage over the winter. Those roots are then replanted the following year. The stalks that form from these roots yield the seeds. The best seeds are selected from that crop and the process was repeated, typically requiring six years before a commercially viable crop of seeds is established. Through trial and error, SPI scientists discovered that commercial seed production required a milder year-round climate and warmer

\textsuperscript{15} W.A. Dixon to Townsend, 16 Nov 1904, SPI, Townsend Office Files, Box 1, folder D, RG 54.
\textsuperscript{16} “Breaking and Establishing High Grade Pedigree Strains of Sugar Beet Seed,” 1907, and “Commercial Production of Sugar Beet Seed,” 1 Nov 1910, SPI, Townsend Office Files, Box 1, RG 54.
soils than were available in Michigan and Colorado, the leading sugar-producing states. Consequently, they conducted research in Washington, Oregon and Arizona. Though these experiments resulted in commercial-quality seed, production could not begin to approach the demands of beet growers. In 1909 Townsend lamented that only 5% of all seed needs were being met domestically. He hoped in vain that independent seed companies would arise to take on the challenge.\(^{17}\) Apparently, such companies were not willing to embrace the risks and long delay associated with commercial production. Further, beet sugar manufacturers were loath to experiment at first because the payoff for domestic seed would not be realized for several years, if at all. In the meantime, foreign seeds were relatively inexpensive, even if they were not adapted to American climates.

Judged by the standards it set for itself, SPI seems to have largely failed in its seed work during its first decade. In 1901, Willet Hays of the Bureau of Plant Industry suggested that the breeding of beet seeds suitable to the varying climates of the United States would result in out-competing European growers. Yet, in 1914, the United States was still reliant on European seeds, bred for European climates. Lamenting the commercial consequences if trade with foreign seed houses were cut off, Townsend opined that “our sugar beet industry in America is dependent upon no interference with Germany and other sections of Europe…”\(^{18}\) If domestic sugar independence and seeds bred for American soils were the primary metrics for SPI’s seed development success, then their work might seem like a qualified failure.

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Such an assessment would be premature, however. Measured by volume of research, networking, and influence, SPI wielded significant clout by the end of its first decade. Its researchers moved from simply gathering industry and experiment station data to partnering in and directing their research projects. By 1909, SPI published thirty eight bulletins and circulars on subjects as wide-ranging as fertilizer, crop rotations, insecticides, the use of beet byproducts and seeds bred for American soils and climates. These publications were distributed either directly to growers, or indirectly through beet sugar companies and agricultural experiment stations. Moreover, as the beet sugar industry grew, SPI’s budget and influence grew astride. By 1910, SPI employed two pathologists, a plant physiologist, four fieldworkers, and several lab assistants and aids at the same time that it developed working relationships at every level of the beet sugar industry. The response from beet sugar manufacturers was often to request state help with their company’s specific problems. Since aiding industrial agriculture was inherent in its mission, SPI was happy to oblige.

Moving Toward Dependency: Research on the Southern Colorado Piedmont

One of the first industry requests for USDA aid came from William Wiley, president of Holly Sugar. In 1910, Wiley operated two beet sugar factories on the Southern Colorado Piedmont, in the Arkansas River Valley towns of Holly and Swink. Though sugar beet agriculture on the Southern Colorado Piedmont was less developed than its northern neighbor, it shared characteristics that made research performed in one region relevant to the other. The Arkansas River was the Southern Piedmont’s corollary to the South Platte River, providing

nearly all of the irrigation necessary to grow beets. Both regions possessed plenty of sun during
the growing season, cool evenings, and soil profiles that could support sugar beet cultivation.
Like its northern neighbor, the Southern Piedmont possessed ample rail access. Wiley’s beet
sugar operations were largely successful during their initial years of operation, as growers
harvested bumper crops and sucrose yields exceeded those achieved by Great Western Sugar.
However, in 1910, yields plummeted and the sugar content within the average beet had fallen by
50%. Disaffected Holly Sugar Growers threatened to discontinue growing beets, and blamed the
company for failing to adequately address their woes. Initially, Wiley brought his concerns to the
experiment station at Colorado Agricultural College (CAC). Believing that the problem resided
in the soil, station director Louis Carpenter appointed his head chemist, William Headden to
analyze soil samples. Headden concluded that “a bacterium in the soil was fixing free
atmospheric nitrogen and that the percentage of nitrates in the soil was so great that it was
ruining (Holly’s) beets.”

Even though experiment station scientists continued to work on Holly’s soil issues, Wiley
was impatient at the fact that CAC scientists offered no immediate remedy. Consequently, he
brought his quandary to Department of Agriculture Secretary, James Wilson. Wilson’s office
transferred the request to Karl Kellerman, plant physiologist and associate chief of the Bureau of
Plant Investigations. Though Kellerman questioned whether Wiley’s problems may just be the
result of soil alkalinity - a common ailment of irrigated soils in the arid West – he referred the
problem to W.A. Orton, the new plant pathologist in charge of sugar beet investigations at SPI.
Unable to attend to Wiley’s problems himself, or spare any of the research scientists in his office,

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21 William Wyckoff, Creating Colorado: The Making of a Western American Landscape, 1860-1940 (New
Haven: Yale University Press, 1999), 101–53.
22 William Spillman, to J.A. Warren, 4 April 1910, SPI, Townsend Office Files, Box 4, Colorado, RG 54.
Orton contacted William Spillman, founder and agriculturalist in charge of the Office of Farm Management Investigations (OFMI), requesting that he complete an assessment of the sugar beet conundrum in the Arkansas Valley. Spillman agreed.\textsuperscript{23}

Spillman was an ideal choice. As a plant scientist by training and the head of OFMI, he focused his energies on applying the research of plant scientists to the economic problems of farmers. In addition, he worked effectively with experiment station researchers at agricultural colleges, as well as collaborated with industry leaders. Before arriving in the Arkansas Valley, Spillman initiated fifteen cooperative projects between USDA scientists and experiment stations. Having placed many college-trained agriculturalists in localities throughout northern and western states, Spillman believed that these specialists should focus their attentions on disseminating relevant agricultural research to farmers through meetings, bulletins, and farm demonstrations. It was this model of education and cooperation between agencies of the state, industry, and farmers that Spillman employed in the Arkansas Valley.\textsuperscript{24}

From his initial 1910 investigations Spillman developed several explanations for Holly’s woes. Disagreeing with Headden, he argued that nitrogen deficiency, not excess, led to low sugar yields. Offering a historical explanation, Spillman argued that for the 30-40 years prior to the advent of the local sugar beet industry, overgrazing had worn the natural grasses thin, grasses that fixed life-giving nitrogen in the soil. Thus, when farmers initially tilled the soil and planted beets, there was sufficient nitrogen only for a few years of high yields before the soil crashed. He also suggested that over-irrigation had saturated some soils beyond use while lack of careful

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\textsuperscript{23} Karl Kellerman to W.A. Orton 16 March 1910, and Orton to Spillman, 30 April 1910, SPI, Townsend Office Files, Box 4, Colorado, RG 54.

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attention to cultivation had stunted the growth of beets. Additionally, Spillman encountered an epidemic of leaf spot on sugar beet plants, an ailment that sapped plant energies during the summer months when healthy plants grow rapidly and concentrate sugar. Finally, in an indirect nod to the need to accelerate production of domestic beet seed, Spillman bemoaned the shortage of quality beet seed available to growers, questioning whether the German companies that supplied most of the Arkansas Valley were not “sending over a lot of poor seed.”

Correcting paltry productivity in the Arkansas Valley required further research; but it also entailed careful treading. If industry or experiment station scientists perceived federal researchers usurping their investigations or dictating the direction of their business, SPI could be shut out of future projects. Consequently, when Spillman wrote to agriculturalist J.A. Warren, his lead researcher in the Arkansas Valley, he emphasized that Warren should make every effort to befriend Holly company executives, agriculturalists, and irrigation experts. Warren was cautioned that, even if he was not impressed by the work of sugar company officials and researchers, he should never display a superior attitude, and always be willing to listen to their advice. BPI Plant Pomologist, G. Harold Powell, followed the same tack when he assured CAC Station Director Louis Carpenter that the USDA would not interfere with its soil studies. Further, Powell explained that the USDA was undertaking this project “as part of a broad investigation of the fundamental problems in the breeding, pathology, and nutrition of sugar beets, which we are carrying on in several states.” In other words, the work was not an attempt to supplant the authority of CAC in Colorado, but part of a nationwide effort to undergird the success of the sugar beet industry. Powell additionally promised that all findings would be shared across

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25 Spillman to Warren, 4 April 1910.
26 Spillman to Warren, 4 April 1910; Spillman to Warren, n.d., SPI, Townsend Office Files, Box 4, Colorado, RG 54.
agency lines. According to Powell’s logic, CAC’s research would not only continue without interference, but through cooperation with SPI and OFMI, it would be granted greater relevance and a wider audience. The reasoning of Powell, Spillman, and Warren also suggested that, for the domestic beet sugar industry to thrive, federal scientists should actively break down administrative and research barriers between their divisions, industry, and experiment stations.

Though Spillman had a vested interest in the success of research in the Arkansas Valley, both he and Warren possessed agricultural expertise that was not specific to sugar beets. So, to oversee Warren and his team of field workers, Spillman procured the services of several SPI researchers. Spillman emphasized to Wiley, Holly Sugar’s president, that Warren would have unfettered access to the advice and help of Charles Townsend. This would seem to be a minor point except that Townsend left his post as director of SPI in 1909 to take a research position at the U.S. Land and Sugar Company in Garden City, Kansas. As a beet sugar manufacturer, and a company whose downstream growers employed the same Arkansas River waters as Southern Colorado farmers, U.S. Land and Sugar was one of Holly’s competitors. Though Townsend never received a paycheck from Holly Sugar, he was indirectly under Wiley’s employ. Townsend’s position suggested that, while the state supported individual beet sugar companies, it refused to confine its research or findings to the boundaries those companies set out for it. As beet sugar companies sought profit from federally subsidized research, the state dispatched its researchers to discrete locales, such as the Arkansas Valley, in order to bolster an entire industry.

Townsend’s role serves to illustrate why that had become increasingly possible. He was one of a growing network of federal scientists who possessed unique knowledge and skills

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27 G. Harold Powell to Louis Carpenter 30 April 1910, Townsend Office Files, Box 4, Colorado, RG 54.
28 Spillman to William Wiley, 4 April 1910, SPI, Townsend Office Files, Box 4, Colorado, RG 54.
desired by industrial agriculture. After heading SPI for almost a decade, Townsend was an expert in all phases of sugar beet agriculture, and had established relationships with every beet sugar manufacturer in the nation.\textsuperscript{29} That knowledge and experience in public employ was coveted by private industry, usually at a higher pay grade. But, Townsend’s unique set of skills enabled him to maintain state ties and conduct research that was not limited by the immediate interests of his employers. Townsend was one of the first out of many SPI scientists to obtain research positions in the sugar beet industry. His example, and the work performed by researchers in the Arkansas Valley in 1910 illustrate the growing interdependencies between the beet sugar industry and state-sponsored science.

The work of sugar beet researchers in the Arkansas River Valley connected Holly Sugar’s production with larger national goals. In 1910 and 1911, SPI and OFMI employed twenty-nine workers on 425 acres. Their research covered the entire gamut of sugar beet farming: irrigation, cultivation, the use of fertilizers and insecticides, crop rotation, and harvesting. Their work even delved into some of the social complications of beet farming such as tenancy and imported labor.\textsuperscript{30} In short, state efforts were a microcosm of the needs of the entire western sugar beet industry. Additionally, the research offered encouragement – in the form of proven research and ongoing support - to regions in the West that were flirting with sugar beet agriculture.\textsuperscript{31} Successful research in Southern Colorado also meant more domestic sugar and less reliance on imports from far-flung locales such as Cuba and the Philippines. More than that, it

\textsuperscript{29} In 1910, Townsend possessed a more comprehensive knowledge of all aspects of sugar beet production than any other American. He published on topics such as beet crop rotations, production costs, beet seed industry history, fertilizer in beet production, yields and sugar content, and mapping out regions where beet sugar agriculture was possible.\textsuperscript{30} Warren to Wiley, 24 April 1910.\textsuperscript{31} “Memo Regarding the Sugar Beet Industry in the United States,” 11 Jan 1916, Townsend Office Files, SPI, Box 3, Townsend Project Reports of no Especial Interest, 1909-1916, RG 54.
declared, in unveiled terms, that the federal government would offer technical and financial support to an industry of growing importance to national interests. That value was about to become more apparent.

Federal government efforts to shape the sugar beet industry accelerated due to events beyond its control. War in Europe highlighted America’s reliance on imported sugar beet seeds and laid bare the weaknesses in domestic production of sugar. The four-year conflict also demonstrated the value of sugar to America’s wartime aims overseas, while underscoring the importance of sucrose in the consumer market. On the Northern Colorado Piedmont, cooperation with state-sponsored regulations for sugar processors and consumers alike were sources of both contention and patriotism.

The start of the European War in 1914 had relatively little impact on sugar production or consumption in the United States, and may have even served to stabilize the domestic beet sugar industry. While there were some concerns over seed shortages, efforts by SPI, college experiment stations, and industry to develop a homegrown seed industry temporarily replaced much of the need for European seed stocks. In addition, an emergency shipment of seeds transported by rail from Kiev to Vladivostock, Russia and thence by ship to the United States in 1915, alleviated fears of shortage.32 Coinciding with the start of the war in Europe, the United States had reduced its tariff on sugar imports from 1.67 cents per pound to 1.25 cents, prompting domestic processors to complain that reduced protection would bankrupt them and their farmers. However, events in Europe precluded that predicted collapse.33 The war decimated the beet sugar industry in Europe, reducing production by over sixty percent. Moreover, the continent’s

33 The 1913 Tariff, which took effect in 1914, further stated that the tariff on sugar would be removed in May, 1916. However, politicians opposed to the new legislation were able to remove that stipulation from the new law. See John Edward Dalton, *Sugar; a Case Study of Government Control*, (New York: Macmillan Co., 1937), 30-33.
most significant sugar-producing nations, Germany and Austria-Hungary, were at war with several of their largest customers, France, Denmark, and especially Great Britain. So, to get their sugar-fix, the British turned to Cuba, a nation more than happy to make up some of the difference. Much of that Cuban sugar would have entered the U.S. market at rates recently reduced by the 1913 tariff. American sugar beet growers, wary of the new tariff, were relieved to see some of the sugar they feared would flood the American market sailing across the Atlantic Ocean. Evidence of this confidence is offered in the fact that the growth of the sugar beet industry in the United continued unabated during the first year of the war. 1915 witnessed the largest domestic sugar beet harvest yet.34

The United States’ declaration of war on Germany in 1917 illuminated the value of sugar and the role played by the Colorado Piedmont in its production. Throughout the first fifteen years of the twentieth century, American consumption of sugar steadily increased to the point where, by 1915, the average American was consuming more than eighty-six pounds of sugar, an increase of fifteen pounds since the turn of the century. Twenty percent of that sugar came from domestic beets. At the start of the war, no state refined more beet sugar than Colorado, and no region sacked more sucrose than the Piedmont, an area whose factories were entirely controlled by Great Western Sugar.35

That sugar was highly prized by the federal government for several reasons during the war. Though sugar plays no part in replenishing the body’s tissues, its sole purpose is to produce

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34 Ellis et al., The Tariff on Sugar, 76.
energy, and no other commodity was capable of producing an equivalent amount of energy in small quantities at a reasonable price. At 1917 prices, sugar provided one hundred calories of energy for six-tenths of a penny. The quickly metabolized vigor offered by sugar provided the most important source of calories for troops overseas. Moreover, refined sugar was dense and easily packed, enabling simple transport during a war when few cargo ships could be spared. Sugar was also an essential wartime consumer good. According to World War I Food Administrator Raymond Pearl, when other foodstuffs are scarce, common in wartime, people instinctively reach for sugar because of the immediate energy it provides. Writing in 1918, he argued that the war emphasized this reality since significant sugar rationing amongst the combatants had resulted in “more discomfort, discontent, and loss of morale than reduction in any other food.” Judging by Pearl’s analysis, the Food Administration was especially interested in any region that could produce large quantities of sugar.36

To encourage production of sugar, as well as other vital wartime foodstuffs, Congress passed the Food and Fuel Control Act, enabling President Woodrow Wilson to form the U.S. Food Administration in August 1917. Led by Herbert Hoover, the Food Administration was charged with advancing wartime aims through the voluntary cooperation of food producers, laborers, and consumers. Sugar consumption was a particularly sticky issue for the Food Administration. While the war in Europe ravaged the economies of America’s allies, wartime demands for increased production of consumer goods resulted in greater domestic prosperity. With more money to burn in the consumer marketplace, demands for sugar-filled products such as soft drinks, candies, ice cream, and baked goods were on the rise. In addition, the Food

Administration encouraged people to preserve fruits and vegetables by canning them, and sugar was the most common ingredient in food preservation. Eventually, reducing consumption would require more than patriotic appeals.37

Production and labor were particularly contentious as well. The need to support the nutritional needs of its allies drew the United States deeper into the sugar shortage in Europe. Since the beet sugar of Europe was not available, Great Britain, France, and Italy turned to Cuba, a nation that also supplied almost half of America’s needs.38 As domestic sugar stocks dwindled in the United States, demand and price increased. Seeking to control both, the Food Administration attempted to fix the price of domestic beet sugar at a level that would ensure a profit for manufacturers while still keeping retail prices at levels acceptable to consumers. While manufacturers such as Great Western were amenable to such an arrangement, growers balked. They argued that their production costs had grown due to technological advances in the industry, increased labor costs, and land appreciation. If sugar refiners stood to make a tidy profit through voluntary cooperation, then growers desired the same. Looming in the background of all of this was a mounting labor shortage. The international conflict had cut off immigration from Eastern Europe, the source of the majority of hand laborers on the Colorado Piedmont. Consequently, labor was both scarce and costly. These sugary complications resulted in an enlarged state presence the Piedmont.39

Beet sugar production provided a focal point where state power, patriotism, and industry collided. Since the United States entered the war in April 1917, there was little that the sugar

37 Bernhardt, Government Control of the Sugar Industry, 25-41.
38 To divide up the Cuban sugar cane crop, the Sugar Board of the Food Administration cooperated with the Royal Commission on Sugar of Great Britain. They agreed to purchase the entire Cuban cane crop, with the United States taking 2/3 of crop, and the remainder being split between the Allied nations of Great Britain, France, and Italy. See Bernhardt, Government Control of the Sugar Industry, 42-67.
beet industry could do to increase production. Piedmont farmers typically signed contracts with Great Western to grow a set amount of beets during February and March and commenced planting the following month. By the time the U.S. declared war, many beet growers had already planted their fields, and the remainder had prepared their fields for planting. Those fields however, soon became a source of worry since beet growers had reduced their beet acreage over the previous two seasons by forty percent due to reduced tariff protections and contract disagreements between Great Western and its growers.40

Those sugar anxieties revealed themselves as the first American troops arrived on the battlefields of Europe in January, 1918. That same month, beet sugar factories were in the middle of processing the 1917 beet crop, a year that showed a drop of 115,000 tons of refined sugar over the 1915 total.41 As Piedmont farmers considered their beet acreage for that year, Thomas Stearns, Food Administrator for the U.S. Food Administration in Colorado, wrote a circular in which he warned that, unless growers planted more acres in beets, a serious shortage for soldiers would ensue. In an effort to elevate growers’ value to the war, he argued that “sugar has become one of the most valuable sustaining foods; it is convenient to transport, easy to serve, essential to the strength of the soldiers…,” concluding that planning a larger beet acreage could prove essential to winning the war.42

A USDA publication the following month continued the patriotic plea for increased acreage while offering practical advice. The circular, commissioned by the War Emergency Food Survey, argued that sugar producers capable of helping the Allied cause throughout the

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40 “Drive Is on to Increase Sugar Beet Acres in Weld County; Alarming Shortage is Shown,” n.a., Greeley Tribune-Republican, 20 April 1918.
41 Ellis et al., Tariff on Sugar, 80.
42 Thomas Stearns, Denver, to Beet Growers of Colorado, 25 January 1918, Box 15, General Correspondence, “H – 85,” Records of the United States Food Administration, Record Group 4, National Archives and Records Administration, Denver, Colorado (Hereafter referred to as RG 4).
world were playing their part. Cuba had increased its production, but “demands on her have been enlarged far beyond her ability to meet them.” The article also implied that sugar manufacturers were making wartime sacrifices since they had reached an industry-wide agreement to sell refined sugar at a fixed price - presumably below the profit they would make on the open market - and since every sugar factory in the nation offered the capacity to process more beets. All that was needed to put Allied sugar production over the top, it seemed, was for growers to send more beets to the factories. While the article acknowledged limiting factors such as the need to maintain a healthy crop rotation and labor shortages, the author argued that more beets and greater attention to cultivation could increase production by twenty-five percent.43

The state’s ability to inspire wartime sugar production was, in part, hampered by its own actions. In October 1917, representatives of the Food Administration had met with domestic sugar manufacturers in an attempt to stabilize wartime prices for sugar. Industry leaders agreed to sell refined beet sugar at a fixed price of $7.25 per one hundred pounds, a price that had increased to $7.45 in January 1918 due to high demand. Food administrators, however, did not seriously consider how such an agreement might impact growers. Those growers complained that, before they would be willing to do their patriotic duty and grow more beets, they desired a larger share of the profits that would certainly accrue to industry. That complaint lingered into April 1918, when most beet contracts with manufacturers were already in place.44

It was not until that month when Food Administrators in Washington, D.C. conducted meetings to address grower complaints. To represent Colorado in those meetings, Governor

44 Bernhardt, Government Control of the Sugar Industry, 3-24.
Julius Gunter sent Charles Lory, the President of Colorado Agricultural College. Noting that Piedmont beet growers had only signed up for about 70,000 acres so far that year – a reduction of 40,000 acres from the previous year – he argued that an agreement to fix payments for beets at a higher rate had to be achieved soon, or the Piedmont would be 60,000 tons short of its production from the previous year. The arguments of Lory and representatives of other beet growing regions in the country carried the day, as the Food Administration approved a rate of $10 per ton of sugar beets delivered to the factories. For Piedmont growers, this was an increase of close to $2.50 per ton. Despite some grumbling, Great Western Sugar, and every sugar company in the nation, agreed to the rate.45

Upon Lory’s return, local food administrators on the Piedmont immediately placed greater pressure on growers to sign up for more sugar beet acreage. In Weld County, the county with the most beet acreage on the Piedmont, a network of wartime volunteers along with representatives from the county, state, and federal government distributed a “Patriotic Pledge” to local farmers. The pledge urged them to plant more beets and provided blank spaces for farmers to “fulfill (their) patriotic duty in co-operating with the U.S. Food Administration in providing sugar for our soldiers and sailors abroad, and our people at home…for the Great Western Sugar Company.” In an accompanying letter, County Food Administrator, C.T. Ahlstrand, tried to assuage fears of a labor shortage in the beet fields by stating that Great Western assured him that there was “an ample supply of field labor available for doing the hand work.” Others, such as C.H. Wolfe, Chairman of the Weld County War Council, served up motivation in practical terms, supplemented by a helping of patriotism, and a dose of guilt. He argued that “an acre of

45 Bernhardt, Government Control of the Sugar Industry, 25-41; “Drive Is on to Increase Sugar Beet Acres in Weld County; Alarming Shortage is Shown.”
beets will produce sugar to keep 40 soldiers in sugar for a year,” and that “a short sugar ration means a tuberculosis-ridden army.” Though calls for increased acreage did not produce record harvests, the new fixed prices resulted in beet acreage in 1918 that equaled the previous year’s total.46

While there is no doubt that the state became a tangible presence amongst beet-growing interests on the Piedmont, the federal government was much more successful when tapping into capitalism than patriotism. Though farmers were well aware of the wartime sugar shortage amongst the United States and her allies, they also understood that a wartime shortfall could create demand that would increase sugar industry profits. So, when the Food Administration and the sugar industry agreed to fix prices at what amounted to a guaranteed profit for sugar refiners without a corresponding grower contract, growers feared they would be shut out of a potential industry windfall. Moreover, it was presumptuous for the federal government to assume that an agreement with industry alone, without also consulting those who operated the farms and labored in the beet fields, would result in a seamless transition to wartime production. Thus, while state food administrators, local officials, and representatives of Great Western Sugar urged farmers on the Piedmont to fulfill their patriotic duty by growing more beets, the farmers themselves were unwilling to fall in line without guarantees that their wartime devotion would be financially rewarded. Apparently, patriotism had a price.

The state placed an equally important value on the consumption of sugar on the Piedmont. On the surface, the region’s consumers played no more of an important role than consumers in any other area of the nation. However, wartime sugar shortages required that domestic sucrose be re-distributed to regions without local sugar factories. In peacetime, the vast

46 “Weld County War Council: Patriotic Pledge – Additional Beet Acreage,” April 1918, C.T. Ahlstrand, Greeley, to Farmers of Weld County,” Box 8, FF 12, RG 4; The Agricultural Situation for 1918, 21-29.
majority of Piedmont sugar was consumed in the Mountain, Plains, and Midwest regions. Since the Food Administration predicted that wartime shortages would hit New England hardest, Piedmont consumers were told that rationing sugar would not only help the Allies win the war, but boost the morale of Americans in the Northeast.47

To reduce consumption on the Piedmont and enable sugar re-distribution to sugar-poor areas of the county, the Food Administration found through experience that relying on voluntary cooperation was insufficient. Until May 1917, food administrators depended primarily on patriotic appeals to consumers to reduce their use of sugar. The allure of sweets and profits through the sugar trade proved too strong to consumers. So, it began issuing a series of rules for the possession, use, and consumption of sugar beginning in May and June of 1918. The Food Administration issued certificates to consumers purchasing refined sugar from retailers to be used at their local grocers. According to federal regulations, urban consumers could not purchase more than two pounds of sugar per trip to the grocery store, while rural customers could purchase up to five pounds. Food Administration guidelines limited consumers to the purchase of three pounds of sugar per household member in a given month, and implored them to never keep more than one month’s supply on hand at any given time. Retailers were charged with enforcing these rules to the point where they were implored to size up unfamiliar customers requesting sugar.48 Restaurants and hotels could not use more than three pounds of sugar for every ninety meals served, and had rules for when and how much sugar could be given to patrons upon request. For example, rules allowed one teaspoon for a cup of coffee, but did not allow any for foods that were naturally sweet such as melons, or typically unsweetened, such as salads.

47 Bernhardt, Government Control of the Sugar Industry, 16-17.
48 C.T. Ahlstrand, Greeley, Colorado, “Federal Food Administration Bulletin to All Firms Retailing Sugar or Flour,” 1 June 1918, Box 8, General Correspondence, FF 12, RG 4.
Colorado food administrators went beyond federal regulations, forbidding restaurants from placing sugar bowls on patrons’ tables. The Food Administration placed manufacturers who employed sugar in processing into various classes by use, and limited their use of sugar to a percentage of what they had used during the same month in 1917. For example, ice cream manufacturers in July, 1918, were allotted 75% of what they purchased in July 1917. Attempting to avoid wasting any food needed in wartime, the Food Administration allowed those in the canning and preserving trade to use their full allotment from 1917. Food Administration rules adjured distributors, wholesalers, grocers, and consumers to be vigilant and either refuse to provide sugar to perceived violators, or report sugar scofflaws to their local food administrator.49

While the aforementioned requirements tended toward the rigid and the doctrinaire, Colorado administrators possessed neither sufficient physical presence to enforce Food Administration regulations, nor clear legal powers. Colorado Food Administrator Thomas Stearns understood this and walked a fine line. In his direct communications with sugar retailers and manufacturers, he threatened accused violators with punitive actions ranging from two years in prison to fines to cutting off their sugar allotment for the remainder of the war.50 Stearns hoped that the threat of state power would hold sugar consumers in check where patriotic appeals failed. On the other hand, Stearns acknowledged the limits of his powers when communicating with his local food administrators. In a July 1918 circular that addressed questions from local food administrators, Stearns reminded them that “we prefer to get full national benefit from the principle of voluntary sacrifice without injecting the element of force,” and “we rely largely on voluntary cooperation.” In other situations, Stearns demonstrated the limits of his authority.


50 See for example, Thomas Stearns, Denver, to Wholesale Grocers of Colorado, 23 July 1918, Box 31, RG 4.
example, when a number of Larimer County sugar beet growers, observing the high costs of stock rations, fed sugar beets to their cattle and sheep instead of delivering them to Great Western, Stearns demurred. Agreeing with Larimer County Food Administrator that such actions were “un-American,” he nonetheless confessed that it was the responsibility of Great Western Sugar to enforce contracts with its growers. Without clear legal mechanisms and manpower, the Food Administration fell back on a combination of patriotic appeals, coercion, and the vigilance of citizen consumers and retailers.\textsuperscript{51}

On the Piedmont, the limits of the Food Administration often presented themselves in the form of real or perceived transgressions. In May 1918, sugar regulations and overconsumption ran headlong into warm spring weather in the region. According to regulations then in effect, soda fountains were entitled to 80% of the sugar they had used from August 1916 to August 1917 for the following year.\textsuperscript{52} According to U.S. Food Administrator, Robert Grant, local soda fountain operator Fred Patterson was pouring an unpatriotically high volume of sugary drinks. In response, Larimer County Food Administrator Fred Stover explained that the previous year was a poor one for local soda fountains due to poor weather. In May 1918, however, those in the soda trade, from manufacturers to soda fountain operators were doing excellent business due to warmer, sunnier conditions, and they were employing copious quantities of sugar in the process to serve their overheated patrons. Consequently, Patterson was not the only retailer serving up a large volume of sugary delights. Further, Stover argued that the warmer, sunnier weather had not only brought out locals, but tourists as well, stating that “there appears to be a great many

\textsuperscript{51} Stearns to County Food Administrators, 6 July 1918, Box 23, FF 167, and Stearns to County Food Administrators, 25 September 1918, Box 21 FF 161, RG 4.
\textsuperscript{52} United States Food Administration, “Summary of Rules Governing Distribution of Sugar,” 27 June 1918, Box 23, FF 167, RG 4.
more people in this city than there was a year ago.” Charged with enforcing wartime food statutes, Stover’s first defense was to offer exceptions to the law and blame travelers who lived outside his jurisdiction.53

The wholesale grocers who mediated between sugar companies such as Great Western and retail grocers often found themselves similarly squeezed by sugar regulations. Their customers were required to present sugar certificates issued by the Food Administration before purchasing refined sugar. Wholesale grocers were common targets for those seeking to skirt Food Administration rules. If caught violating regulations, their license to sell sugar could be revoked. Moreover, since their customers could choose from among several wholesalers, it was important to maintain the appearance of patriotic cooperation.54

The case of Hickman-Lunbeck Grocery of Greeley illustrates the issue. In September of 1918, two separate complaints had been filed against Hickman-Lunbeck. According to F.J. Lunbeck, one of his salespeople was being accused of making statements to a customer, Brown Cash Store of nearby Fort Lupton, that he could provide all of the sugar they needed. This was a particularly contentious statement during that month since Ft. Lupton retailers were experiencing a sugar shortage. Sugar imbalances were not uncommon, as unscrupulous retailers and consumers often tried to buy sugar without their allotted sugar certificates, and thus obtain more than they were allowed, resulting in occasional shortages. Lunbeck claimed that no statement regarding extra sugar was made to Brown Cash Store, or any other for that matter, and that he was in possession of a Food Administration certificate for all of the sugar shipped to Brown. He wondered aloud in his correspondence with Weld County Food Administrator, Ahlstrand,

“whether others are making false statements derogatory to us,” and urged an investigation so that his company’s name could be cleared. The tone of Lunbeck’s letter suggests that he was less concerned with the legal consequences of violating Food Administration rules than with the social and commercial consequences of failing to cooperate with wartime restrictions.55

The experience of sugar consumers on the Piedmont during World War I illustrates both the growth and limits of state power in the region. The presence of federal food administrators at the state and local level showed that consumption limits on wartime items such as sugar were more than paper tigers. However, the primary enforcers of state power did not receive a government paycheck. For example, C.T. Ahlstrand was not capable of investigating the many complaints that crossed his desk. He relied on thirty-five agents, most of them volunteers, to investigate claims of impropriety. And, many alleged violators were identified by citizen consumers acting out of either patriotic concerns or, in the case of commodities like sugar, acting out of the fear that violators were taking more than their fair share, effectively stealing from the meager allotments of law-abiding citizens.56 Retailers and those using sugar commercially were generally anxious not only to follow regulations, but to provide every appearance of doing so. State power over sugar consumption derived from convincing Piedmont consumers that sugar was essential to the war, and so were the rules that regulated it.57

55 F.G. Lunbeck, Greeley, Colorado, to Robert Grant, Denver, 16 September, 1918, Box 15, General Correspondence, FF H, RG 4.
56 Ahlstrand, “Federal Food Administration Bulletin to All Firms Retailing Sugar or Flour,” 1 June 1918, Box 8, General Correspondence, FF 12, RG 4.
57 Chris Capozzola has argued that following government regulations during World War I was part of what he calls a “culture of obligation,” and that obedience to wartime laws were viewed by most Americans as the foundation of a free government. Further, Capozzola argues that the lack of state power to enforce regulations was replaced by a vigilant citizenry that employed what he calls “voluntary coercion” to keep potential scofflaws in line. See Christopher Joseph Nicodemus Capozzola, Uncle Sam Wants You: World War I and the Making of the Modern American Citizen (New York: Oxford University Press, 2008), 3–20.
The work of the Food Administration during World War I highlights the importance of state power in industrial agriculture. By the time the United States entered World War I in 1917, the USDA had already invested great energy in helping sugar producers such as Great Western to succeed and grow. By undertaking cooperative projects with industry, such as those in Holly, Colorado, the federal government developed networks of relationships with sugar executives. Those relationships were strengthened, as state scientists such as Charles Townsend were recruited by the sugar industry to head their own research teams. The growth of the sugar industry not only paralleled the expansion of state sponsored agriculture; the two were mutually constitutive. So, it comes as no surprise that state officials and sugar executives had little trouble coming to an accord on fixing prices for refined sugar at the outset of the war, or even that residents in sugar-producing regions such as the Colorado Piedmont generally lined up behind wartime regulations. Moreover, even though Food Administration officials failed to immediately recognize the need to strike an agreement on the price to pay growers for beets, it is noteworthy that, when they finally did in April 1918, the $10 per acre guaranteed price was a significant increase on pre-war payments. World War I emphasized the industrial value of sugar producing regions like the Piedmont, an emphasis that would continue in the years to come.

By most outward appearances, state efforts to support the growth of the sugar beet industry prior to World War I had been a qualified success. The Division of Sugar Plant Investigations was able to cooperate with industry and land grant colleges to increase yields, combat disease and insect infestations, replenish soils, apply irrigation, and develop effective crop rotations. In addition, the tariff on sugar imports – unchanged from 1897 to 1914 - allowed cane sugar from Cuba and U.S. insular possessions such as Hawaii and Puerto Rico to enter the country profitably while offering sufficient protection for the domestic beet sugar industry.
Statistics on the U.S. Beet Sugar Industry bear this out. In almost every year from 1901-1914, the domestic production of sugar beets and consumption of beet sugar increased while the number of factories shot up and industry profits were significant and stable. During that same period, grower yields steadily increased and the price per acre they were paid for their beets rose regularly.58

The physical and fiscal decimation of World War I in European sugar-producing countries threw into motion changes in the beet sugar industry that would alter the landscape in places like the Colorado Piedmont, and result in state actors playing an expanded role in subsidizing and regulating the industry. Food Administration calls for increased production and reduced consumption were motivated not only by fears of wartime sugar shortages, but also by concerns that high demand and low supply would result in astronomical price increases. Until 1917, domestic sugar production - dominated by the beet sugar industry - had been marked by steady, predictable gains. The potential for large price increases, such as the wartime shortage offered, had the capacity to bankrupt the industry since high prices might tempt farmers to grow more beets than their soil or crop rotations could sustain. It also tempted nations such as Cuba to vastly expand their sugar cane acreage and flood the United States with cheap sugar. While the need for sugar was high during the war, the Food Administration worried that an unregulated market would result in overproduction following it.

Though the Food Administration succeeded in obtaining industry-grower cooperation and assigning a wholesale price for refined domestic sugar, they were concerned with how Cuba, the

world’s largest sugar exporting nation, might upset the balance. To achieve price parity, the Food Administration drew up plans to create the Sugar Equalization Board. Designed as a government-controlled corporation, and authorized by President Woodrow Wilson in July 1918, the Sugar Board possessed executive authority to purchase the entire Cuban sugar crop annually for the remainder of the war, as well as negotiate wholesale prices with the domestic beet and cane sugar industries. When the Sugar Board was formed, the Food Administration had already agreed to purchase beet sugar for 7.5 cents per pound. The Sugar Board then negotiated with the Cuban government for the purchase of the entire crop of raw Cuban cane sugar for 5.5 cents per pound. After freight, refining costs, and profit margins were considered, all refined sugar – foreign and domestic – could be purchased by wholesalers for 9 cents per pound.59

The Sugar Equalization Board was not incorporated with the idea that it would outlast the war. Its contract was set to expire on December 31, 1919. However, all but one of the members of the Board were concerned that putting an end to wartime regulations would throw the sugar market into turmoil. Consequently, they recommended to Congress in December of 1919 that the Sugar Equalization Board be chartered for another year with the intent to purchase Cuba’s cane crop. Congress agreed and passed the McNary Bill, authorizing the president to purchase the 1919-1920 Cuban cane crop. Though President Wilson signed the bill, he chose not to exercise the rights it accorded to him, arguing that there was no longer any need for wartime sugar controls. As of February 1920, the Sugar Equalization Board ceased to exist.60

The release of government control over the sugar industry revealed the extent of sugar shortages and unleashed a tidal wave of investor speculation that resulted in volatile sugar prices. Beginning in November 1919, when the Sugar Equalization Board sold off its last stocks of

59 Bernhardt, Government Control of the Sugar Industry, 25-49.
60 Dalton, Sugar: A Case Study of Government Control, 57-73.
sugar, the price of sugar rose steadily, largely due to lack of supply. In addition, manufacturers of products that relied on sugar, fearing supply shortages, rushed to secure stocks of raw sugar from sugar cane markets, further decreasing the amount available to consumers and increasing retail prices. In the midst of this sugar inflation, speculators rushed into the sugar market hoping to make a quick profit. The upshot of this turmoil was that wholesale prices for sugar ballooned from 7 cents per pound in November 1919, to over 20 cents per pound in May 1920. When more Cuban sugar entered the market that month, and American sugar beet growers planted record acreage in response to high prices, the market collapsed, and sugar prices dropped below five cents by the end of the year. This was the beginning of a long and steady decline in sugar prices that would continue into the 1930s.

How did sugar go from an undersupplied product in high demand during World War I to a commodity with depressed prices and overproduction in just a few short years? The work of the U.S. Food Administration played an important role. During the war, its calls for increased production and a guaranteed price for Cuban sugar stimulated vast increases in production in that island nation. But Cuba by itself could not fill the sugar void. American sugar beet growers, such as those on the Piedmont, responded to the shortage by planting larger crops in the years immediately following the war. And though the European sugar beet growers had been decimated by the war, they resumed production and had almost achieved pre-war levels by the mid-1920s. Finally, technology and industrialization played paramount roles. In the early 1920s, the cane sugar industry succeeded in synthesizing strains of sugar cane that were heavier

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61 Bartow Elmore offers a useful case study on Coca-Cola’s insatiable appetite for sugar during this period, explaining how the soft drink manufacturer sought a secure supply of sugar when it was hard to come by. See Bartow J. Elmore, *Citizen Coke: The Making of Coca-Cola Capitalism*, First edition (New York: W.W. Norton & Company, 2015), 76–109.

and contained larger concentrations of sugar, resulting in greater production per acre. Finally, America’s insular possessions, Hawaii, Puerto Rico, and especially the Philippines, were inundated with investors from the United States eager to outfit their outdated sugar mills with modern cane processing technology. The transformation that resulted was so dramatic that the Philippines was able to increase its sugar production 243% during the 1920s with minimal increases in sugar cane acreage. The value of these technological changes was accentuated by the fact that American overseas possessions paid no tariff on sugar exported to the United States. Since costs of production in those possessions remained well below those in the beet sugar industry, insular cane sugar growers could tolerate low prices and remain profitable.63

In an environment where cheap sugar imports were growing, American state actors retained a continued interest in protecting the domestic sugar industry. The simplest way to protect the industry had always been the tariff, whose use and impact became more pronounced in the 1920s and early 1930s. After the sugar turmoil of 1920, Congress increased the tariff on Cuban sugar from 1 cent per pound to 1.6 cents. As the price of sugar continued to drop into 1922, Congress again acted, passing a Cuban tariff at the rate of 1.76 cents per pound. Finally, in 1930, as the Great Depression tightened its grip on the United States, Congress approved a 2 cents per pound rate on Cuban sugar.64

One of those tariffs, the 1922 Fordney-McCumber Tariff, offers a glimpse into the state’s ongoing interest in domestic beet sugar.65 The tariff included an addendum that allowed the president to make adjustments in import rates upon the recommendation of the U.S. Tariff

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63 Dalton, Sugar; a Case Study of Government Control, 40–73.
64 Since 1903, Cuba paid only 80% of the import tariff on sugar. However, since Cuba provided almost all of America’s imported sugar in the 1920s, it is of little consequence to quote any other rates.
65 Though the tariff protected both beet and cane sugar in the United States, cane sugar represented less than one-quarter of domestic production in 1922, and continued to decline by comparison.
Commission. In 1924, the wholesale price of sugar had risen to 6 cents per pound, and beet sugar companies such as Great Western were making record profits. The previous year, as prices were already increasing and retail costs for consumers were going up, President Warren Harding requested a Tariff Commission investigation. The Commission, operating on the assumption that the purpose of the sugar tariff was to protect producers only to the degree that such protection would create parity in the consumer market, recommended that the rate on Cuban sugar be reduced to $1.23 per pound, a decrease of over 50 cents. New president Calvin Coolidge refused to act on the recommendation, stating that he disagreed with the findings of the commission. But the notoriously reserved Coolidge went on to state that a robust beet sugar industry was essential to domestic food independence, and that the consumer was best served when plentiful beet sugar enters the market. Finally, Hoover parroted the most common arguments of American beet sugar officials when he expressed fears that a lack of tariff protection would “destroy our domestic (beet) industry,” and that a robust tariff would enable the farmer to share in the nation’s prosperity.  

Sugar beet growers on the Piedmont could not have agreed more. In the 1920s, a period of growing insecurity in most of the major agricultural industries in the nation, the Piedmont was planting record numbers of beets. Between 1922, when the Fordney-McCumber Tariff was passed, through 1930, when Congress enacted the Hawley-Smoot Tariff, Colorado beet growers increased their beet acreage from 148,000 acres to 243,000 acres. Throughout that period, Piedmont growers produced more than two-thirds of that total. During the same period, the value of their crop doubled. One the eve of the Great Depression, Piedmont beet growers were

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refining 20% of the nation’s beet sugar.\textsuperscript{67} In a decade of worldwide sugar excess and falling prices, state subsidies played a crucial role in the growth of Piedmont farmers, and the industry they depended on most.

Overproduction and financial collapse during the Great Depression rendered the tariff ineffectual, prompting a more hands-on regulation of the sugar industry. This came in the form of the 1934 Jones-Costigan Act, an amendment to the Agricultural Adjustment Act (AAA) of 1933. Also referred to as the Sugar Act, this amendment added sugar to a list of seven basic agricultural commodities that had production quotas. Aimed at bringing production in line with consumption, the Sugar Act allotted an annual quota of 1.55 million tons to the domestic beet sugar industry, slightly less than one-quarter of the nation’s consumption. Should consumption rise in succeeding years, the beet sugar industry was entitled to 30% of that increase. Growers who voluntarily reduced their acreage so as not to exceed production goals were given federal payments based on an annual processing tax.\textsuperscript{68}

The Jones-Costigan Act represented a monumental shift in how the state subsidized sugar. Prior to 1934, the tariff was employed to stabilize a fledgling industry, stimulate production, and reduce dependence on imported sugar. It brought revenue into the federal treasury and income for the sugar industry and its growers. Despite its undeniable influence on industry growth, the tariff was a hands-off subsidy. It had no direct influence on where beets were grown, the methods of their cultivation or harvest, how sugar was processed and

\textsuperscript{67} Colorado Agricultural Statistics were consulted for the following years: 1922, 1923, 1926, and 1930. See Agricultural Statistics of the State of Colorado, 1922-1934, (Denver: Colorado Co-operative Crop and Livestock Reporting Service, 1935).

distributed, or the relationship between industry leaders, growers, and farm laborers. Conversely, the new quota system placed the state into factories and into growers’ fields by telling them, collectively, how much they should produce. Further, the Sugar Act transformed sugar companies into federal payroll agents and administrators since the state allotted quotas to each beet sugar company – companies then distributed that quota among its growers - and required industry agents to deliver payments for fallow land. The system of quotas and payments offered more depression-era stability than growers had previously enjoyed. The Jones-Costigan Act not only regulated production, but it also had a profound impact on how growers used their acreage, since they had to consider more carefully how much sugar they could wring out of each acre of land. This transformed how state-supported science interacted with the beet sugar industry in places like the Piedmont.

Chemistry and Machinery Crystallize State/Industry Dependence

The Sugar Act also represented a change in philosophy toward sugar production that mapped neatly onto how the state approached its relationship with the beet sugar industry. Prior to World War I, the Division of Sugar Plant Investigations (SPI) invested much time and treasure into researching sugar beet agriculture and touting its benefits to regions of the country that had not embraced it. Its reasons consisted of one part nationalism, one part ecology, and one part economics. Armed with a strong tariff and a growing budget, SPI scientists claimed that more acres in beets would result in less reliance on imported sugar. They also tried to demonstrate that sugar beet agriculture, with its dependence on rotating crops, meticulous cultivation, and integration with the fattening of stock such as cattle and sheep, was healthy for the land and the long-term viability of farmers. Finally, SPI posited that sugar beet agriculture was profitable.
However, after World War I, investors had little interest in opening new factories since farm prices for commodities such as sugar beets were falling, or volatile at best. Moreover, with cheap cane sugar available in increasing quantities from island producers such as Cuba and the Philippines, adding acreage and factories into the mix seemed risky. In addition, though the tariff provided a strong wall of protection, there was no telling when political winds might shift and that wall could crumble. Consequently, SPI and its network of scientists shifted away from stressing more acres and factories and toward greater efficiency on existing acreage, an essential emphasis once the Sugar Act placed formal quotas on U.S sugar production.\(^\text{69}\)

Highlighting efficient use of sugar beet acreage was especially valuable for the irrigated lands of the West, and the Colorado Piedmont in particular. During the 1920s there simply was very little new land available on the Piedmont to grow sugar beets. All of the irrigation water necessary to grow beets had been claimed. So, short of a massive increase in water storage, the remaining acreage in the region had to be used for dry land farming or stock grazing.\(^\text{70}\) In addition, for those who did grow beets in the region, it was often financially necessary to continue farming this vegetable. Since their irrigated acres were among the most valuable in the West, making those lands pay required a crop that could fetch a high price.

In the drive for efficiency, there was one tiny obstacle that loomed like a fortress: seeds. Prior to the 1940s, the term ‘beet seed’ was a misnomer, since each seed was composed of up to five seed germs, each occupying a separate compartment. When the seed within each compartment germinated, it formed part of a root ball whose shoots eventually broke the surface

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as several tightly compacted beet plants, each one competing for water, nutrients, sun, and growing space. They had to be thinned in order to thrive; yet no machine existed that could do the labor. Consequently, for sugar beets to grow to full maturity, they required precise hand thinning and an army of seasonal laborers.\(^\text{71}\) Further, to support optimum growth and sugar content there was a narrow window of time, generally a few weeks in June for the Colorado Piedmont, in which to accomplish the task. Once sugar beet plants were thinned, they required one or two weedicings during the summer, generally by the same laborers. Even harvesting beets was largely a hand chore. Since mature beets possess a taproot that extends several feet below the surface of the earth, excavating them required a great deal of torque, involving two stages – loosening and removal. Since the 1930s, machines existed for loosening, but not removal. During the 1920s and 1930s, growers for Great Western Sugar alone relied on thousands of laborers - primarily German-Russians, Mexican nationals, and Mexican-Americans – to do the work. As industry and state-sponsored scientists strove for sugar beet efficiency, they were confronted with the fact that over half of the costs associated with transforming seeds into factory-ready beets came from horse and human labor.\(^\text{72}\) And before machines could replace horses, monogerm seeds had to replace humans.\(^\text{73}\)

In lieu of this breakthrough, SPI scientists cooperated with researchers from land grant universities and the beet sugar industry on experiments aimed at greater productivity on each acre of land. If the labor costs were to remain high, then perhaps more sugar could be squeezed out of seeds and soil. Of course, this had been one of the primary aims of SPI since it became a


\(^{73}\) Deborah Fitzgerald argues that industrial machinery was an essential part of the 1920s emphasis on agricultural efficiency. Though the logic of efficiency was very much a part of the changes wrought in sugar beet agriculture, the mechanization of the industry did not occur until the 1940s and 1950s. See Fitzgerald, 1-9.
division of the USDA in 1901, but with one significant change. Prior to the 1920s, most efforts at increasing sugar per acre involved the application of sound cultural practices such as crop rotation, soil maintenance, and following timelines and methods for effective planting, cultivation, harvesting, and application of water. Whether sugar beet growers employed these methods or not, it was not for lack of available information. So, armed with an ever-increasing budget in the 1920s and 1930s, SPI researchers shifted their focus toward chemical treatments for sugar beet seeds and plants, and a variety of manufactured fertilizers. This not only signaled changes in research methodology, but implied a loss of grower agency. After all, farmers could, and did, conduct their own experiments on all manner of planting, cultivation, and harvesting, but few possessed the education necessary to comprehend the newer research, and even fewer maintained chemistry laboratories on their properties. Consequently, this move to a more specialized knowledge also served to insulate professional agricultural scientists from the farmers who might employ their research. Thus, employing the new research implied unquestioned reliance on expertise and on the professional scientists who were its purveyors.

By the 1920s, Piedmont sugar beet growers were not likely to question that reliance on scientific expertise. In the twenty years since the beet sugar industry had been established in the region, a clear division of labor had been established. Though growers may have quibbled with researchers over small issues such as the right dates on which to apply irrigation water or the row spacing of beets, they had learned that larger research questions pertaining to such topics as seed breeding and soil science were best left to industry and agri-state experts. Consequently, it was

75 After World War I, much of the new research involved creating organic chemical compounds from large quantities of materials such as ammonia and chlorine left over from the war. Work was done primarily by chemists with advanced degrees and the sort of knowledge and instruments unavailable to farmers. On how the war propelled these advances, see Edmund Russell, War and Nature: Fighting Humans and Insects with Chemicals from World War I to Silent Spring, Studies in Environment and History (New York: Cambridge University Press, 2001), 37-94.
likely that few growers paid any attention to the professional relationships between scientists at CAC, SPI, and Great Western Sugar. The science practiced by those professionals was primarily disseminated to growers by company field men and by CAC’s extension agents. If growers questioned company practices, their concerns were far more likely to revolve around annual beet contracts. This focus on contracts reflected a logical relational trajectory between growers, industry, and agri-state scientists. But, beginning in the 1920s, sugar beet researchers were poised to make fundamental changes to how growers managed their sugar beet lands.

During the 1925 growing season, SPI undertook multiple projects in the sugar beet growing regions of the West where chemicals were essential to their labors. In the Arkansas Valley of Colorado, SPI junior pathologist, Dewey Stewart, collaborated with American Beet Sugar lead researcher, Anton Skuderna, in a project that received assistance from Colorado Agricultural College’s (CAC) regional experiment station. Sugar beet productivity in the region was being hindered by cercospora, or leaf spot, a disease characterized by small spots on sugar beet foliage, resulting in withered plants, declining sugar content, and up to 40% loss in beet tonnage. Stewart and Skuderna hoped that emulsifying seeds with a host of chemicals prior to planting might result in earlier germination and more vigorous plants that could resist cercospora, or oven inoculate plants against certain diseases. Michigan State University plant pathologist and SPI consultant, George Herbert Coons provided twenty-five strains of sugar beets for the experiments. Referring to the treatments as ‘disinfectants,’ Skuderna and Stewart employed chemicals available in a typical science lab such as mercury, formaldehyde, and copper carbonate. A list of treatments used also included products concocted by DuPont and

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Bayer, American and German corporations that had recently entered the agricultural chemical market.\textsuperscript{77}

Skuderna’s end of the season correspondence with W.W. Tracey of SPI in Fort Collins embraced chemicals in the field. Identifying disinfected seeds that resisted leaf spot most effectively, along with those that produced the greatest tonnage of beets and highest sugar content, Skuderna planned future experiments that crossbred seeds to create hybrids with the most desirable traits. Much of the work completed by SPI and American Beet Sugar that year prioritized the use of chemicals to boost productivity. By using statements such as “worthwhile,” “outstanding,” and “indicative of promise,” Skuderna indicated a wholehearted approval for this methodological approach.\textsuperscript{78} Throughout the late 1920s and into the 1930s, these experiments continued and broadened to include chemical fertilizers, additional beet-growing regions, and a larger variety of chemical inputs.\textsuperscript{79}

Due to the chemistry involved in extracting sugar from beets, the sugar beet industry had always attracted large numbers of chemists.\textsuperscript{80} Prior to the 1920s, that term generally applied to the factories where chemical processes were employed and refined to extract maximum quantities of sugar from beets. Greater emphasis on efficiency and production turned sugar beet fields into chemistry labs as well. From seed treatments to fertilizer to shielding beet plants from

\textsuperscript{78} Anton Skuderna to W.W. Tracey, 13 November 1925, Records of the National Agricultural Library, Special Collections, Beltsville, Md., Sugar Beet Collection Reports (Hereafter NAL), Box 2, FF: Rocky Ford, 1925.
\textsuperscript{79} See for example, “Summary of Commercial Field Tests with Treated Sugar Beet Seed Made by the American Crystal Sugar Company at Chaska, Minnesota in 1935,” NAL, Box 2, 1935 Field Work.
diseases and insects, state-sponsored scientists hoped that chemistry could alter the lifecycle of the sugar beet.

Experiments performed with this new of chemical products also formed the basis of collaboration and professional advancement amongst state and industry scientists. The 1925 sugar beet research in the Arkansas Valley illustrates this. George Herbert Coons was hired from Michigan State University’s Department of Plant Pathology in 1925 to expand SPI’s research profile and oversee the work in the Arkansas Valley. His seed experiments propelled him into the position of USDA Senior Plant Pathologist in Charge of Sugar Plant Investigations in 1929. Coons led SPI until 1955, when Dewey Stewart replaced him.81 Stewart began his investigations of leaf spot on sugar beets in the Arkansas Valley and advanced in SPI as a result of his work.82 Anton Skuderna maintained a collaborative relationship with SPI through the 1920s as director of the research department at American Beet Sugar. He used this position to propel him into the position of Principal Agronomist for SPI by 1930. By the end of that decade, Skuderna was at the forefront of SPI’s other major project: mechanizing the sugar beet fields.83 Chemistry and state/industry collaboration were tools for agricultural efficiency and professional advancement as these men demonstrated. Their work and careers also show how the line that separated state and industry interests in sugar blurred as state-subsidized science and industrial profit overlapped.

H.E. Brewbaker offers another example of a career and research trajectory that obscured the boundaries between state and industry. Raised on a Midwestern farm, Brewbaker earned a degree in agriculture from the University of Illinois in 1921, and went on to earn a doctorate at the University of Minnesota in plant genetics in 1926. After teaching at Minnesota’s college of agriculture for several years, he was hired by SPI in 1930 as an associate agronomist to conduct research at the experimental farm on Colorado Agricultural College’s (CAC) campus in Fort Collins.  

His immediate supervisor was Anton Skuderna.

Like other researchers at SPI, Brewbaker forged connections with industry that demonstrated common interests and impacted his own career arc. As SPI established a larger presence on the Piedmont, primarily through research conducted at CAC’s experiment station, Great Western Sugar not only collaborated with state scientists on projects, but enlisted them to write articles for its growers in its publication, *Through the Leaves*. In the early 1930s, Brewbaker was SPI’s most consistent contributor, regularly offering scaled down versions of his research. In articles such as “Better Stands of Sugar Beets,” Brewbaker omitted the tables, charts, and previous studies cited in his scientific publications. Instead, he offered a straightforward description of how much seed to plant, appropriate spacing between plants upon thinning, and potential yields if his advice were followed. He also attempted to soothe fears that growers might have about embracing science to improve efficiency.  

In Brewbaker, Great Western found a hard-headed scientist capable of speaking directly to its growers.

The language in Brewbaker’s articles also demonstrates how closely the push for efficiency emphasized by SPI and industry goals coalesced. In one of his first articles in *Through

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the Leaves, Brewbaker encouraged farmers to experiment with new ideas emerging from sugar beet scientists, reasoning that “the aim of every successful farmer, as with heads of other business concerns, is to lower the cost of production,” implying that research, business, and Great Western’s growers all shared the common goals.\textsuperscript{86} In a later article promoting the use of machinery in the fields, Brewbaker spoke to growers in the same language that Great Western might employ, declaring that the goal of the grower is “…to produce the largest amount of sugar per acre at the lowest cost per unit of production.”\textsuperscript{87} In Brewbaker’s writings, the aims of state-sponsored science and industrial agriculture were synonymous. Great Western Sugar agreed. In 1937, they offered Brewbaker the job of Research Director. He accepted.\textsuperscript{88}

One reason why researchers such as Brewbaker and Skuderna were able to transition so seamlessly back and forth between state-sponsored and industry science was that many of their projects were collaborative and shared the same goals. Brewbaker was anxious to demonstrate this reality when Great Western hired him in 1937. So, he collaborated with his former boss, Anton Skuderna, to pull together a meeting of scientists and researchers from industry, the USDA, and agricultural colleges who shared a common interest in sugar beet science. They called themselves The American Society of Sugar Beet Technologists (ASSBT). Meeting in Fort Collins in 1937 for the first time, the organization included representatives from agricultural colleges in Colorado and California, several USDA scientists, and representatives from three seed companies and thirteen beet sugar companies. Focusing especially on sugar beet agronomy and breeding, they stated that their purpose was to “foster all phases of sugar beet and beet sugar research, and to act as a clearinghouse for the exchange of ideas resulting from such work.”

\textsuperscript{88} “Dr. Brewbaker Joins Company,” \textit{TTL} 25 (1937): 86.
During its first decade, ASSBT grew to include most of the major state and industry figures conducting sugar beet research.\textsuperscript{89}

Despite so much collaboration and emphasis on productivity and efficiency, sugar beet technologists failed to produce a monogerm seed and much of the cultivation labor was still being done by hand. Attempts to change that received a huge boost in 1938 when the land grant colleges in the two largest beet sugar producing states, Colorado and California, formed a collaborative program with the USDA and twelve sugar companies. Backed by the United States Beet Sugar Association, an industry organization that funded projects benefitting beet sugar interests, and the Division of Farm Power and Machinery of the USDA, the new program used research space and land from the University of California, Davis, and Colorado Agricultural College. Its first order of business was to gather and test all of the cultivation and harvesting machinery on the market. Researchers collected and tested thirty-five machines that claimed to save labor through better planting, cultivation, harvesting, and even excavating intransigent beets from frozen soils.\textsuperscript{90} Though testing yielded some recommendations for which machines were better than others, and a number of reports, nothing significant emerged. Since most of the same scientists seeking beet breakthroughs were also members of ASSBT, their research dominated the presentations and discussions of the 1940 ASSBT meeting in Denver.\textsuperscript{91}


\textsuperscript{91} S.W. McBurney and E.M. Mervine, “Semi-Annual Report: January 1 – August 31, 1940, Sugar Beet Machinery,” 31 August 1940, SPI, Farm Power and Machinery, Box 1, RG 54.
Then, in 1941, Roy Bainer, a USDA researcher conducting trials at UC Davis, developed a machine capable of shearing seed germs into individual seeds, an innovation that promised to revolutionize the industry. It enabled individual seeds to be planted at uniform distances, significantly reducing the need for hand thinning. The industry immediately jumped on the seed shearing train. In 1942, Great Western built four facilities to segment beet seeds, and Vice President, D.J. Roach stated that the company would have an unlimited supply of segmented seeds in 1943, predicting that half of all of its grower acreage would be planted with the new seed. That year, Bainer claimed that sheared seed would save three million hours of labor, an argument that possessed particular salience owing to war-induced labor shortages. Segmented seed spawned a host of complementary machines. Chief among them were planters, thinners, and cultivators. Momentum created by the war and by the segmented seed breakthrough led to more mechanization, as USDA and private researchers developed machines that could loosen, dig, and pile beets in one operation. By the end of the war, it appeared that the technological infrastructure to mechanize the entire industry had arrived. Perhaps the state’s beet sugar efficiency mission had been accomplished.

Yet, the bureaucratic mission of state-sponsored science colluded with industry needs to preclude such a tidy conclusion. The beet sugar industry depended on state-subsidized research, while USDA scientists relied on the needs and requests of industry to set its agenda. Consider a 1946 report of the USDA-sponsored Sugar Advisory Committee. Made up of representatives of beet and cane sugar companies, as well as growers’ associations, the committee reviewed past

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94 “Sugar Beets Mechanized.”
accomplishments and delivered recommendations for the future of the industry. The report largely gave credit to federally sponsored research in the 1920s and 1930s for making the industry more efficient, thereby rescuing it from catastrophe. Specifically, the report cited scientific work that addressed sugar beet diseases, seeds adapted to beet-producing regions, cultivation innovations, and reducing the high labor costs associated with beet production. Implying a growing state/industry collaboration, the report then offered an agenda for future state-subsidized research. While crediting researchers for developing segmented seed, the report opined that problems with this technology and adapting machinery to it resulted in only a 30-40% overall reduction in labor costs. Moreover, the report argued that industry would not reduce its labor costs sufficiently until single germ seed could be produced genetically, and a host of machinery were refined around that innovation.95 According to the report, the need for monogerm seed and full mechanization was “urgent,” and the only way to combat “the impact of cheap foreign sugar.” The report further argued that, after full mechanization, the most pressing need was to combat weeds and insects in the beet fields by experimenting with a host of new chemicals, insecticides, and fertilizers to eradicate the threat. Among the other frontiers for state sponsored sugar beet science included disease-resistant seed strains, research and education in economic management for the new mechanized sugar beet farm, and developing additional uses for sugar beet by-products. Without saying it directly, the report implied that the state was a permanent fixture of the beet sugar industry.96 They had become dependent on one another.

95 As the report was being written, a coalition of sugar companies and researchers were in the process of bringing Russian national, V.F. Savitsky to the United States. Savitsky had succeeded in breeding monogerm sugar beet seed in Russia. Once in the United States, he was employed by the USDA, working at Oregon and Utah’s experiment stations. See Brewbaker, “Single-Germ Beet Seed a Commercial Possibility,” TTL 38, no. 4 (1950), 29-31.
This was not a foregone conclusion at the turn of the century, when the first beet sugar factories were erected on the Piedmont, and state scientists offered support for a fledgling industry. However, when the state’s push for domestic sugar met industry inadequacies, the result was a gradual blurring of the lines that separated state and industry missions. Prior to World War I, researchers with SPI learned that the most efficacious methods to support the beet sugar industry involved responding directly to industry requests for help and then applying the results of their research to other locales and companies. As state-sponsored scientists became recognized experts in sugar beet agriculture, in part through the relationships they developed with industrialists, they were able to move seamlessly between federal and industry employment. International and domestic crises such as World War I and the Great Depression accelerated the blurring of lines between the beet sugar industry and the state. In both circumstances, federal intervention to stabilize the industry accelerated a push for greater efficiency in sugar beet agriculture, resulting in greater emphases on the employment of chemicals and mechanization in the beet fields. As research intensified, so did the nature of state/industry collaboration, to the point where the remaining boundaries separating industry and the state disappeared. What began as state support for a neophyte industry became a relationship of mutual dependency by mid-century.
Chapter 5: Water and Work, Water and Power

No single natural resource was more essential to Piedmont agriculture than water, and its supply was scarce. The source of the region’s water is the South Platte River and its tributaries. One would be hard pressed to find a western river that, in proportion to its flow, carried a heavier agricultural burden than the South Platte. When all of its tributaries are considered the waterway carries an annual average of 1.6 million acre feet of water, paltry when compared to the 15 million acre feet carried by the Colorado River, or the astounding 190 million acre feet carried by the Columbia River.¹ Further, the South Platte’s modest flow is not designed to easily accommodate agricultural needs. The majority of the river’s water plunges from the mountains and courses through its channels during the months of May and June, before the heat of summer when crops require the most water. So, if farmers wished to tap the majority of the region’s flows, it was necessary to go beyond engineering canals and ditches to divert water to their farms. Beginning in the 1880s, irrigators built dozens of storage reservoirs to claim the South Platte’s limited supply before it flowed away. As farmers put more acres to the plow and adopted thirstier crops, they required additional water storage and more sophisticated systems of delivery. Each new stressor on the Piedmont’s water supply required increasingly complicated engineered solutions.

Though scientists could engineer the flow and storage of water, they possessed little power over who controlled water. Settlement patterns and shared need determined that. To govern how water would be apportioned, initial Piedmont settlers took a cue from the Colorado Gold Rush that began in 1858. Miners working a claim agreed to allow appropriation of water

¹ An acre-foot is the amount of water necessary to cover one acre of land in a foot of water. It is the measurement most commonly used by farmers to describe their water appropriations. Whenever feasible, the acre foot will be the unit of measurement used here.
from an adjacent stream in the amount necessary to process their claim on a first-come-first-served basis. Farmers, many of whom had initially come to Colorado intending to mine, adopted the same principle. Under this system, users who claimed a given volume of water to irrigate their lands were given that right in perpetuity, with claims on each stream honored in the order they were claimed. But few farmers possessed the individual resources to move water from stream to farm. So farmers sought engineered solutions. Pooling financial resources, they formed mutual irrigation companies to build reservoirs that could store water during the late spring and early summer when flows were at their peak, and to gather in even more water during years when snowpack in the Rocky Mountains was above average. Farmers owned stock in these irrigation companies that entitled them to quantities of water in varying amount depending on how much stock they owned, the water available, and the seniority of their water rights. On the Piedmont, these mutual irrigation companies were the primary entities used to acquire and distribute the limited water supplies of the region.

At first glance, these attempts at controlling water provide support for one piece of what Donald Worster has called a hydraulic society. According to Worster, irrigation in the West has resulted in the consolidation of power into the hands of those with the capital and expertise to manipulate it. Further, irrigation canals were unnatural places where water flowed straight from diversion to headgate to farm, or as many irrigators, hydrologists, and legislators affirmed, water

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2 On the origins of the doctrine of prior appropriation as found in mining law, see Donald J. Pisani, To Reclaim a Divided West: Water, Law, and Public policy,1848-1902, 1st ed (Albuquerque: University of New Mexico Press, 1992).


flowed “toward money.” Certainly, there was plenty of money at stake in Piedmont agriculture. There is a direct corollary between the value of the crops grown on the Piedmont and development of water resources. The modestly valuable potatoes and wheat of the nineteenth century yielded to the more lucrative sugar beets during the first half of the twentieth century, and corn, more valuable still, predominated after World War II, primarily to provide feeds for the commercial feedlots of the region. Each crop and development required more water and greater financial investment. Simply owning water created wealth, as the value of irrigated lands on the Piedmont grew consistently from 1870 to 1960 and at a pace that far eclipsed dry land farms. The value of senior water rights grew even more rapidly, as water increasingly represented security against drought and generated greater profit in the marketplace. Measured by a cursory view of irrigation works and accumulated wealth, the Piedmont seemed like a hydraulic society.

On closer analysis though, Piedmont geography and dispersed water management limited centralized control and concentration of capital, contrary to Worster’s assertions. Piedmont geography defied the centralization of control over water into a small number of hands. Unlike much of the irrigated West, the region possessed few ideal locations for large reservoirs. Consequently, the growth of farming on the Piedmont in the late nineteenth and early twentieth centuries was accompanied by small-scale irrigation companies that built modest reservoirs for farmers/stockholders. Despite some consolidation, none of these companies wielded control

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6 For a graph showing the water requirements of various crops on the Piedmont during specific times of the year, see Big Thompson Soil Conservation District et al., Watershed Work Plan Home Supply Watershed, Larimer and Weld Counties, Colorado (Lincoln, Neb.: U.S. Soil Conservation Service, 1964), 43.
8 According to Elwood Mead, the first professional irrigation engineer in the West, two of the South Platte’s tributaries possessed almost 100 irrigation reservoirs by 1903. See Elwood Mead, Irrigation Institutions; a
over significant portions of the irrigated landscape. Though limited water supplies resulted in numerous conflicts, it was typical for irrigation companies to temporarily store water, or transfer water between other companies and users. Individual farmers commonly offered excess supplies of water in a given year to adjacent farmers, operating under the assumption that the favor would be returned in future years. This did not preclude speculation. It was common for irrigation companies to buy and sell excess water, and the sophisticated network of canals and ditches facilitated the water market. However, no irrigation company possessed water significantly in excess of the needs of its users. Consequently, they were cautious about selling excess water in one year that might leave them short in future ones. Even Great Western Sugar, the largest private water user in the region through the first half of the twentieth century, occasionally found itself scrambling for water rights. Though it built various small reservoirs and purchased a host of water rights in the early twentieth century, the company struggled to obtain desirable senior water rights that were secure in times of drought. Irrigators on the Piedmont resisted centralized control, and though water was an instrument of wealth – and some inequality – that wealth was widely distributed. For water users on the Piedmont, possession of water, though limited, motivated users more than control of it.

Donald Pisani’s argument that western water development was not guided by coherent federal planning, but instead was decentralized and guided by local conditions and circumstances, parallels much of the Piedmont’s water development in the nineteenth and twentieth centuries. Pisani argues that water users determined water policy far more than public officials and that, in fact, efforts by state and federal officials to direct water development lacked coherency and were rebuffed by local water users. On the Piedmont, late-nineteenth-century

*Discussion of the Economic and Legal Questions Created by the Growth of Irrigated Agriculture in the West, Use and Abuse of America’s Natural Resources* (New York: Arno Press, 1972), 143–179.
efforts by Colorado legislators to oversee water appropriations to make sure users received fair allotments failed. Senior appropriators and irrigation companies were especially resistant to this kind of centralized planning since they commonly took far more than their allotted share. State planning threatened to expose and regulate this practice. In the same way that centralized planning for water resources failed in the Colorado legislature, it was also rebuffed at the federal level. During the mid-1930s, when the massive Colorado-Big Thompson Project (C-BT) was proposed, debated on and finally passed, local concerns largely won the day. The federal Bureau of Reclamation lobbied for and built the infrastructure of the C-BT, which delivered 320,000 acre-feet annually to Piedmont water users from the headwaters of the Colorado River. However, contrary to past precedent, Reclamation did not limit C-BT users to a 160-acre irrigation maximum. Further, though Reclamation managed the diversion of water from the Colorado River headwaters to the Piedmont, once that water arrived in the reservoirs, canals, and ditches of farmers, it was entirely managed by local irrigation companies. This lends evidence to Pisani’s argument that, by the 1930s, Reclamation had become more of a construction agency that commanded more power in Washington DC than in the regions where it built water projects. On the Piedmont, irrigators were interested in state and federal financial support for water projects, but were generally successful at resisting centralized directives.

The need for a widely available and broadly dispersed water supply suggests that we must pay closer attention to the work of water engineers, and the publicly funded agencies and institutions that supported their work. Piedmont water users with senior water rights – and, broadly speaking, more wealth – were little vested in the fair distribution of water rights.

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Without precise water measurements, senior appropriators often drew more water than they were allotted. With little private interest or money directed at irrigation engineering, the science of water measurement developed in the public sphere through the work of the USDA and Colorado Agricultural College (CAC). Engineers there developed instruments that cheaply and precisely measured water flow in rivers and ditches, and reduced water losses from seepage and evaporation in reservoirs and irrigation ditches. Their work increased the water supply available to junior appropriators and facilitated the expansion of the Piedmont’s irrigated landscape. Moreover, because public science produced the majority of innovations in irrigation without a clear industry beneficiary, those innovations were broadly distributed. Unlike state-sponsored sugar beet research, which clearly subsidized a specific industry, publicly funded irrigation engineering research assisted a broad swath of users.

The effectiveness of state-funded research often foundered on issues of local control. During the 1920s and 1930s, while national pressure mounted to make agriculture more efficient and reliant on technology, irrigation companies were selective in their appropriation of new irrigation technologies. Some of the most pioneering work in irrigation technology during the period was being conducted by Ralph Parshall at CAC. Though he was widely respected in agricultural circles – Parshall was a farmer before he became an engineer – Parshall foundered when he pushed irrigation companies to consolidate and implement new technologies that would have made their operations more efficient. To a large degree, this resulted from the mission of irrigation companies. They existed to acquire and provide water for their users. As companies formed to protect water rights, they were conservative and risk averse. Investing monies in new technologies - especially innovations such as measuring devices that could prove that their users were taking too much water – presented debt they were reluctant to take on. Ironically, federal
and state agencies would have better served farmers and their own financial interest better by providing funds to install new irrigation technologies rather than building massive water projects such as the C-BT. Decentralized water management essentially blunted the implementation of irrigation technologies that would have made water delivery more efficient.

Broad distribution of water largely facilitated Great Western’s industrial hold on Piedmont agriculture. Though the company sought vertical integration of the natural resources necessary to process sugar, it required sugar beets to process more than it needed control over water. Before farmers chose to grow beets for Great Western, they required confidence that their water rights were sufficient to bring a profitable crop to harvest. Because Great Western needed beets, the growers’ interests became their own. Since water was a major factor of production, Great Western was interested in limiting its costs, for itself and for its growers. So, in the early twentieth century, the company sponsored the building of several reservoirs. Great Western then made the new water source available at reasonable prices to potential growers since the company stood to gain more from increased acreage in beets than from selling water. Further, in the 1930s, when Piedmont residents were debating whether to support the C-BT, Great Western immediately lined up behind it.¹⁰ The company argued primarily that the costs of additional water were minimal compared to the value of the crops they could raise from it – sugar beets foremost among them. In Great Western’s case, broadly distributed water supported industrial agriculture, while exercising control over the water its growers used presented risks that outweighed the potential benefits.¹¹

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Engineering and cooperation guided Union Colony settlers’ approach to water in 1870.\textsuperscript{12} Pooling their money, settlers purchased valuable railroad lands adjacent to the Cache la Poudre River, just a few miles from its confluence with the South Platte. Their money was also earmarked for the building of ditches that would divert stream water for residential and farming purposes. The colony, which quickly changed its name to Greeley (named after \textit{New York Tribune} editor and colony co-founder Horace Greeley), soon discovered that water engineering was more complicated and costly than originally predicted. Their initial investment provided only enough capital to build a ditch for municipal water.\textsuperscript{13} After Greeleyites approved additional funds to complete an irrigation ditch, they struggled to make water function as they hoped it would. Poorly cut channels resulted in eroded banks, and ditches without consistent fall lines caused water to either move too swiftly or pool up in one location. Water that seeped out of ditches or percolated from over-watered lands created swampy and unusable farmland and drainage nightmares for the future. Abundant water resulted in unwanted growth on canal banks and eventually generated ditch-clogging debris. In their cost calculations, Union Colony founders assumed incorrectly that maintaining ditches would present minimal costs. Colonists not only lacked the funds for irrigation but also the engineering knowledge to carry it through. Despite these fits and starts, Greeley attracted new settlers and quickly became the most

\textsuperscript{12} The social philosophy of the Union Colony is more fully laid out in Chapter 1. Here, that philosophy is employed only to provide the reader with the knowledge of how colonists appropriated water for municipal use and irrigation.

\textsuperscript{13} Initially, colonists approved four canals for an estimated $20,000. These canals were intended to water 120,000 acres. Though all four of them were eventually built, only two of them were constructed by the colonists. Their total cost was $87,000. See Rose Laflin, \textit{Irrigation, Settlement, and Change on the Cache La Poudre River} (Colorado Water Resources Research Institute, Colorado State University, n.d.), 17.
populous town on the Piedmont. The need for irrigation animated the development of new settlements; all of which hoped to learn from Greeley’s initial failures in irrigation engineering.\textsuperscript{14}

Piedmont settlers who attempted to consolidate power through control over water generally failed, forecasting the de-centralized control over water that would follow. Less than two years after the Union Colony arrived, another group of settlers organized the town of Fort Collins. Situated along the banks of the Cache la Poudre River upstream of Greeley, Fort Collins also tied its fortunes to irrigated agriculture. Ignoring Greeley’s prior appropriation of water, Fort Collins initially diverted water with impunity. In the drought year of 1874, this created conflict, as Fort Collins farmers drained most of the river’s flow before it reached Greeley’s main canal. Amidst threats of armed conflict, Fort Collins farmers agreed to release some of the river’s flow. Heavy late summer rains dampened further conflict. Prior to 1874, Greeleyites trusted that their earlier appropriation of water would protect them from later arrivals who settled upstream. As a consequence of the conflict with Fort Collins, Greeleyites pushed for laws that would recognize their right to divert water before those who arrived after them. Though prior appropriation had been established by legal precedent in the Colorado Territory in 1874, it was not yet enshrined in its statutes. Ironically, Fort Collins irrigators soon arrived at the same conclusion as its Greeley neighbors when newer settlers sought to draw river water upstream from their own claims. Piedmont communities quickly learned that it was more important to cooperate with one another to gain sufficient water rather than gamble on corraling an abundance of this slippery resource.\textsuperscript{15}

\textsuperscript{14} David Boyd, \textit{A History: Greeley and the Union Colony of Colorado} (Greeley, Colo: Greeley Tribune Press, 1890), 29–64; James F. Willard, \textit{The Union Colony at Greeley, Colorado, 1869-1871}, University of Colorado Historical Collections, v. 1 (Boulder, 1918), xiv–xxxi; Laflin, \textit{Irrigation, Settlement, and Change}, 16–22.

Corporate control of Piedmont irrigation also failed. During the decade from the mid-1870s through the mid-1880s, several British investor groups sought to profit by building irrigation works. Since most of the land in river bottoms was already irrigated, they targeted the fertile bench lands above the river bottoms. This required that they build longer canals than had been previously constructed, since the only way to water the lands above the stream was to draw water from upstream at a point higher than the lands to be irrigated. Investors hoped to reap a windfall from residents who settled on these lands. One such enterprise, named the North Poudre Land, Canal, and Reservoir Company, was initiated in 1880 by Englishman Frances L. Carter-Cotton and involved a 52-mile canal that diverted water from the North Fork of the Cache la Poudre River. Cotton estimated that the canal would only run twenty miles, cost $35,000, and be capable of irrigating 16,000 acres. He was sorely mistaken. Short on cash, he called on various investors to complete the project. Once completed, it failed to attract sufficient water users. When the project did not turn a profit, Carter-Cotton fled Fort Collins in shame and $150,000 in debt. Like Carter-Cotton’s project, most corporate attempts to control water on the Piedmont failed. Though there were many reasons for these failed ventures, common ones included poor planning and management, inadequate funding, local animosity, complications in water delivery, and the fact that the horde of water buyers never materialized. Though most of these corporate irrigation enterprises failed on their own, Colorado farmers pushed to legally limit their powers. One point of contention was the use of royalties by irrigation companies for the delivery of water. In 1887, B.A. Wheeler refused to pay royalties, whereupon the Northern Irrigation Company refused to provide him with water. Wheeler sued, and in 1888, the Colorado Supreme Court ruled, in *Wheeler v. Northern Irrigation Company*, that irrigation companies could not charge royalties on the delivery of water. Subsequently, the state legislature passed a
bill stating that irrigation companies could only make a “reasonable charge” on carrying and delivering water to users. In the first two decades following the founding of the Union Colony, the shared need of Piedmont farmers led them to fiercely resist attempts to consolidate power over water into a few hands. Moreover, even though prior appropriation determined the order in which users were entitled to water, irrigators learned to cooperate around their shared need for a scarce resource.\textsuperscript{16}

By the end of the nineteenth century, water law in Colorado severely limited centralized control of this resource. In 1872, the Colorado Territorial Supreme Court issued its first water decision, \textit{Yunker v. Nichols}, which stated that water is a necessity in the state and allowed irrigators to cross private property to divert water to their own lands. This case effectively separated water rights from land ownership, setting a legal precedent that departed from water law in the rest of the nation. In the eastern half of the United States, where humidity and abundant rainfall were the rule, riparian rights dominated. Derived from English common law, riparian rights gave a land owner with property adjacent to a stream the right to use that water for practical purposes such as turning millstones or powering a turbine, but forbid the landowner from altering the stream’s course, reducing its volume, or polluting it. Further, water rights inhered to the land; so they could not be bought and sold. Riparian rights allowed use but not possession.\textsuperscript{17} By contrast, \textit{Yunker v. Nichols} implied that land ownership and water rights had been separated in Colorado since a water right permitted the holder to divert water no matter how far away the user was from the stream. Cooperation was also implied in the court case since


\textsuperscript{17} Pisani, \textit{To Reclaim a Divided West}, 11-12.
water appropriators had to cross private boundaries in order to build and maintain ditches. Colorado’s 1876 constitution reiterated prior appropriation and the supremacy of water access over private property rights in what became known as the Colorado Doctrine. Reproduced throughout the West, the Colorado Doctrine also empowered the state to condemn water rights that were not for ‘beneficial use.’ In 1881, the state solidified prior appropriation when it formally ordered and quantified water rights in each of the state’s watersheds, ensuring that, when water was scarce, there was an orderly process for determining which users would receive water first and in what amounts. Laws and rulings prior to 1900 also affirmed the rights of water users to exchange water. This meant that a user might temporarily trade a water right vested in one stream, ditch, or reservoir for another somewhere else. Since so many of the canals and ditches throughout the state were interconnected, water exchanges were simply a matter of gravity and finding the most efficient conveyance. Finally, early water law guaranteed the rights of users from one watershed to divert water from another. On the Piedmont, this right proved crucial since its ratio of population and irrigated farmland to available water often left Piedmont residents lacking for water.\(^{18}\) In short, Colorado water law effectively resisted corporate capitalism and speculation; and though users held tightly to their individual ownership of water rights, law, scarcity, and practicality encouraged them to cooperate.\(^{19}\)

To a degree, the economics of irrigation dictated cooperation among irrigators. As the Union Colony quickly learned, diverting water from its natural course was an expensive endeavor and possession of a water right meant nothing without the means to divert that water. Moreover, Colorado’s ‘beneficial use’ provided no incentive for leaving water in the stream.

\(^{18}\) For a quick primer on the major court cases that establish the right to divert and exchange water between users see Laflin, *Irrigation, Settlement, and Change on the Cache La Poudre River*, 41–53.

Without the physical and financial means to divert, water rights could be forfeited. So, most Piedmont water users vested their water rights in mutual irrigation companies or purchased rights from companies. The majority of these companies formed when users pooled their resources and water rights to purchase and/or build irrigation works. In some ways mutual irrigation companies – also called ditch companies - operated like corporations. Farmers owned stock in the company and voted on company decisions – building and maintaining canals and reservoirs, buying and selling water rights - in proportion to the amount of stock held. Here, the similarities ended. Unlike corporate shares traded on Wall Street, ditch company shareholders valued their shares in water, not cash. Based on the amount of water available in a given year, and the seniority of the shareholders’ water rights, each share of stock entitled its possessor to a given quantity of water. Thus, shareholders and those who used the company product were one and the same. Typically, mutual irrigation companies were responsible for building and maintaining reservoirs and larger canals, while individual irrigators built and maintained the ditches coursing through their own properties. Mutual irrigation companies arose and functioned out of shared water needs.\(^{20}\)

Many factors precluded mutual irrigation companies from consolidating their holdings into larger companies. These included their origins, their shareholders, the value of water, and the Piedmont landscape itself. Most mutual irrigation companies formed when a group of irrigators in a well-defined area recognized their shared need. Since speculation was generally not a founding principal, most irrigation companies remained small.\(^{21}\) In 1900, there were


\(^{21}\) There were notable exceptions to this. In the 1880s, several mutual irrigation companies formed to buy water rights, build canals, and then hoped to profit from those who bought nearby lands and needed irrigation water. However, cost overruns, local distaste for corporate enterprises, and court cases such as *Wheeler v. Northern Irrigation*, which limited their right to charge royalties on water delivery, caused most of these companies to fail.
dozens of these companies on the Piedmont. More than 50% of them served fewer than 5,000 acres of farmland, and some had fewer than forty stockholders. Irrigation engineer Chris Thornton points out that irrigation and risk-aversion in regard to water have always gone hand-in-hand on the Piedmont. Water was not just one among many resources farmers needed. It was the keystone without which the whole system of farming collapsed. Taking risks with water was akin to taking risks with their livelihoods.22 Risk aversion was facilitated by the Piedmont landscape as well. Consolidating power in water on the Piedmont required the ability to store water from spring run-off; however, there were few good storage sites to build large reservoirs in the region. Consequently, all but a few of the region’s reservoirs were broad, shallow, and could only store modest quantities of water. Further, most were built and jealously guarded by a single irrigation company and its stockholders. Elwood Mead, Colorado’s first professional irrigation engineer, who later went on to head the USDA’s irrigation investigations and chair the Bureau of Reclamation during the 1920s, observed in 1903 that there were at least fifty small irrigation reservoirs on the Cache la Poudre River alone.23 Each of these irrigation puddles represented a dispersion of power.

The Consolidated Home Supply Irrigation Company (hereafter referred to as Home Supply) offers an example of the scramble to obtain water rights on the Piedmont, as well as the decentralized and dispersed nature of power over water in the late nineteenth and early twentieth centuries. Founded in 1881, Home Supply appropriated water from the Big Thompson River in some of the lands between Loveland and the small town of Berthoud. By the early 1880s, the
company’s water users had appropriated all of the dependable water rights from the Big Thompson. In fact, users had appropriated more water than was in the stream. Consequently, Home Supply – and most other most mutual irrigation companies at the same time – sought to increase the supply in the system. The most effective way to do that was to build more storage. Home Supply made application to the state to divert 278.84 cubic feet per second (c.f.s.) from the direct flow of the stream. It was granted. While this was more than sufficient to supply its users, the Home Supply possessed right #50 from the Big Thompson. This meant that the company could only claim the new water for its users once the direct flow rights of the previous forty-nine users had been satisfied. Typically, the Big Thompson had to be flowing at a rate of more than 1,000 c.f.s before Home Supply was entitled to a drop. For the eleven years in which records are available between 1888 and 1900, that flow occurred in only five years. When that flow was achieved during the height of spring run-off, generally in June, it often occurred for only a handful of days, and it rarely lasted more than a few weeks. Home Supply’s stockholders therefore rooted for heavy mountain snows and concentrated run-off.

Heavy snow melt was of marginal value without storage. So, Home Supply prioritized reservoirs to contain flows during the brief periods in which it would exercise its water rights.

After its users formed Home Supply in 1881, they employed their water rights to construct a dam

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24 Flow rate is used to determine the volume of water in a stream and is measured in cubic feet per second (c.f.s). Reservoir storage and farmers’ water allotments are measured in acre-feet. 43,560 cubic feet of water equals an acre foot. A flow of 1 c.f.s. for 24 hours provides roughly the equivalent of 2 acre feet of water. In 1900, farmers on the Piedmont required a minimum of one-half acre foot of water per acre of irrigated crop. Thirsty crops such as alfalfa, potatoes, sugar beets, and corn required more. Using the above figure, and Home Supply’s 278 cfs allotment during spring run-off, the company could divert and store 550 acre feet of water for each day it could use its water right. Three weeks of diversion could effectively fill its storage reservoirs in 1900 and irrigate over 15,000 acres. During most years, the Big Thompson did not flow faster than 1,000 c.f.s for long enough to fill the company’s reservoirs.

on the main stem of the Big Thompson, upstream of its users, re-directing water into company ditches. Most of that water then flowed into Lonetree Reservoir, where it awaited the needs of Home Supply stockholders. Once each week, at the request of stockholders, Home Supply’s supervisor released water from the reservoir into the company’s main canal in the amount requested by all of its users that week, whence it headed down the canal toward farmers’ headgates. Unused water, whether in the form of seepage or water not drawn from the ditch, generally gravitated back toward the Big Thompson River where it was coveted by downstream users. Home Supply was not about to let the water slip through its fingers that easily, so its stockholders approved Boedecker Reservoir in 1888. Unlike Lonetree, Boedecker had no rights to store the direct flows of the Big Thompson River. As an exchange reservoir, it pulled water from the river only when Home Supply agreed to release an equivalent amount of water back into the Big Thompson River. In other words, Home Supply gained no new water rights with the building of Boedecker Reservoir. It simply gave the company more storage and delivery options. Boedecker’s additional benefit came from its higher elevation. Many of Home Supply’s shareholders lived above Lonetree Reservoir. Prior to the building of Boedecker in 1888, they could only fill their ditches during brief periods when the company was legally entitled to divert water directly from the river. When Home Supply built Boedecker at a higher elevation, those stockholders gained access to flows throughout the growing season. Through the system of exchange, Home Supply could serve more customers without actually owning any more water.27

26 Boedecker Reservoir was originally named Mariano Reservoir, after the first Anglo settler in that region of the Big Thompson River. It is more commonly called Boedecker Reservoir, named after another settler in the region who formerly owned land now filled by the reservoir. To avoid confusion, I will use the name Boedecker throughout.

27 Keirnes, Water, 7-8.
Reservoirs and exchanges may have increased the water available in the Big Thompson Watershed, but these efforts could not completely mask the limited irrigation water available to farmers in the region. Consequently, Home Supply found itself in competition with three other mutual irrigation companies, the City of Loveland, and small farmers over the little water that was available and who would gain priority in its use. Such disputes often involved the courts. In 1898, The New Loveland and Greeley Irrigation Company applied and received a permit to divert water from the Big Thompson River above Boedecker Reservoir during years of scarcity, in order to fill its own reservoir. Home Supply subsequently sued New Loveland, arguing that this would deny water to Boedecker, which had been built chiefly to supply water in lean years. H.N. Haynes, Home Supply’s attorney, further argued that the company would not only lose water via this new diversion, but also through New Loveland’s leaky reservoir since significant water was lost through seepage. Since New Loveland did not possess accurate gauges to measure its storage, it could then potentially divert more water to replace what gravity had stolen. In other words, Home Supply claimed that, if New Loveland could neither measure nor control water’s movement, then it should not be allowed to divert it. This was an argument of convenience, since all reservoirs on the Piedmont leaked to some degree, and devices to measure water storage and flow were notoriously inaccurate. Further, recent experience taught Home Supply that its initial 1881 diversion dam, further upstream on the Big Thompson River than any structure involved in its dispute with New Loveland, could be quite lucrative. In 1895, three years before New Loveland sought its diversion rights, the growing City of Loveland paid Home Supply $1,250 for the privilege of diverting its city water from a point above the company’s
most upstream diversion dam. At any rate, Home Supply lost its case with New Loveland since the company could not prove significant harm from its water rival.28

Turn-of-the-century water conflicts between Home Supply and its competitors were rendered more acute when the sugar beet industry arrived on the Piedmont in 1901. Since sugar beets required more water than any market crop being cultivated in the region, companies such as Home Supply were anxious to secure additional water rights. In part, this was because stockholders recognized their need for additional water. However, they were also aware that surplus water would be in demand and therefore could be sold for a tidy profit. As Great Western Sugar prepared to open its Loveland factory in 1901, stockholders from Home Supply and three other irrigation companies signed up to grow sugar beets for the new sugar refiner.29 All four irrigation companies scoured the region for unappropriated water. The largest source of those rights came from the Big Thompson and Manufacturing Company Ditch, originally dug in 1863, and possessing water rights senior to any of the four companies vying for its flow. Farmers using that ditch claimed over 146 c.f.s of water, yet farmers using it could not prove that such an amount of water was being put to beneficial use. Further, since the canal was overgrown and in disrepair, Home Supply and its competitors were able to prove that it was not capable of carrying more than 75 c.f.s. Once they had proven lack of beneficial use, each company sought its share of the river’s flow. In what turned out to be a shrewd legal maneuver, Home Supply attorney H.N. Haynes proposed to the company’s shareholders that they limit the period of the year in which they were allowed to divert water from the river in exchange for a larger share of

29 The other companies were The New Loveland and Greeley Irrigation Company, Louden Ditch Company, and Handy Ditch Company.
its flow. Since Home Supply possessed more reservoir storage than its competitors, the plot worked. On April 6, 1903, Boulder District Judge James Garrigues ordered that Home Supply receive 46 c.f.s. of additional annual flow from the Big Thompson. Easily the largest share awarded to any of the four companies, the water had to be diverted by July 14 each year. In most years, that turned out to be sufficient for the company to claim its full share of water. The new water paved the way to irrigate more lands in Home Supply’s territory, and enticed farmers to grow sugar beets for Great Western Sugar.\(^{30}\)

Home Supply’s legal success did not portend growing wealth or control. True, its irrigators acquired a more secure supply of that precious raw material, but courtroom decisions assured its solvency more than its wealth. Prior to 1903, the company was more than $10,000 in debt because it needed to repair its main diversion dam after it collapsed in 1895. Despite issuing $40,000 in bonds, the company maintained a backlog of repairs that included shoring up seeping reservoirs, cleaning its main canal (which had become clogged with weeds and debris), employing underground tiles to move water from saturated fields back into company canals, and installing various metering devices to measure out water fairly to its shareholders. Home Supply’s new water, some of which could be sold on demand, facilitated payment of debts, and the completion of some repairs. But according to Reg Keirnes, former Home Supply supervisor, repairs were minimal, primarily because shareholders were unwilling to spend more money than was necessary to keep sufficient water flowing into its ditches. There were insufficient votes to line the entire main canal with concrete, a move that could have drastically reduced seepage. In addition, more efficient water usage could have been accomplished by pressuring users to cut

down trees and other vegetation from the banks of irrigating ditches. Even though one
cottonwood tree was capable of sucking as many as 1,000 gallons of ditch-water each day, and
Home Supply possessed the legal right to remove them, the company generally eradicated only
vegetation that impeded water’s direct flow. Typical of most of the mutual irrigation
companies on the Piedmont, Home Supply’s success did not consist in speculative wealth or
growing power, but in its ability to round up a more secure supply of water for its users.

While the story of irrigation in the West can certainly be told as one of taming wild rivers
for the sake of capital accumulation, we find when we follow the water itself that it still adhered
to the laws of physics and performing the same tasks in a ditch that it previously performed in
the stream. Trees and vegetation were still drawn to the banks of canals and ditches, sucking
water from the channel as if it were a natural stream. Even where mutual irrigation companies
were able to convince their stockholders to pay for lining the main canals with concrete, farmers
still contended with unwanted – and sometimes even desirable – vegetation in their own earthen
ditches. Water’s gravity-fed path still defied human control. Reservoirs and ditches seeped, and
water from the surface evaporated. Excess water from one irrigator’s land percolated across
property boundaries, requiring farmers to cooperate around maintenance of ditches. Water also
carried organic materials, minerals, and the physical force of its flow. Silt clogged reservoirs and
decreased their carrying capacities, altered the flow of water in canals and ditches, as it also did
in streams, and leached soils of valuable nutrients such as phosphorous, while carrying salts
downstream that damaged the soils of other irrigators. Dams could be compromised or even
collapse, as occurred with Home Supply’s main diversion dam in 1895. While there is no
question that humans developed institutions and physical structures that altered the nature and

32 On the collapse of Home Supply’s main diversion dam, see Keirnes, Water, 4-6.
utility of the South Platte Watershed, water remained a slippery resource that could erode, clog, and re-channel its containments. In that sense, the water in a ditch was not unlike the water in a stream.\textsuperscript{33}

Demand for water on the Piedmont increased dramatically in the early twentieth century. This was facilitated most dramatically by the rapid growth of the beet sugar industry and its sole refiner in the region, Great Western Sugar. By 1907, the corporation controlled all nine beet sugar factories on the Northern Piedmont, and by 1913 Piedmont factories refined more domestic sugar than any other region in the country.\textsuperscript{34} In short order, the majority of farmers employing irrigation on the Piedmont also became growers for Great Western. Despite its growing influence in the region, the company’s need for water made it more dependent than dominant. Though sugar beets were the most lucrative crop in the region, farmers still had to agree to grow them. Sugar beets were part of a crop rotation that required copious water. Beets could typically be grown in only two years out of seven on a plot of land since they depleted the soil of valuable nutrients. To restore some of those nutrients, especially nitrogen, growers planted alfalfa in two or three years out of seven. Of the cash crops in the region, only potatoes required more water than sugar beets, and alfalfa gulped more water than both of them.\textsuperscript{35} None of this took into account the needs of Great Western’s factories. Though they only processed beets into sugar from November through January in most years, for that period they required more daily water than any city in Colorado save Denver. In fact, according to its own 1919 figures, during beet

\begin{footnotesize}
\textsuperscript{33} For a book length treatment on the hybrid relationships that resulted from human attempts to control water for irrigation, see Mark Fiege, \textit{Irrigated Eden: The Making of an Agricultural Landscape in the American West}, Weyerhaeuser Environmental Books (Seattle: University of Washington Press, 1999).


\textsuperscript{35} For a description of the water needs of various crops in the Piedmont see Hemphill and United States, \textit{Irrigation in Northern Colorado}.
\end{footnotesize}
slicing operations one factory required 6.5 million gallons of water daily, which was equivalent to supplying the daily water needs of a city of 136,000 people.  

Moreover, since Great Western was a new appropriator on the Piedmont landscape, it had to find ways to squeeze more water out of a watershed that had already been wrung dry. As a junior user, Great Western needed to find water from somewhere, but taking it from farmers in the region, most of whom grew sugar beets for the company, was akin to biting the hand that fed its sugar empire.

In Loveland, where Great Western erected its first factory, the company sought to obtain water wherever it could find it. To lure beet sugar entrepreneurs to town, the City of Loveland guaranteed 200,000 gallons of water daily to Great Western, and the construction of a pipe to transport it. To obtain additional water rights in Loveland, the company obtained the services of H.N. Haynes, the same lawyer who represented Home Supply. When it was clear that Home Supply and other irrigation companies would obtain additional water from the Big Thompson and Manufacturing Company Ditch, Haynes passed along the news to Great Western, which proceeded to purchase water from both Home Supply and The Greeley and Loveland Irrigation Company. Some of that water was stored in Loveland Reservoir, where both the City of Loveland and the Greeley and Loveland Irrigation Company stored some of their water. That fact put Great Western’s factory needs in conflict with the water rights of its fellow reservoir users. During the winter, the sugar company was often the only water user, since farmers were not irrigating their fields. According to Haynes, in 1903, the company was entitled to 4 2/3 c.f.s. from the reservoir, but certain unnamed water managers observed that Great Western was diverting more than 6 c.f.s. to its factory. The water was being drawn from Lake Loveland, and water measurements were not precise enough to determine actual diversion. Despite this,

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Haynes cautioned his client, stating that the total flow of the Big Thompson River in the winter—after all diversions besides Great Western’s were taken into account—was likely less than what the company was withdrawing. In other words, he feared that, poor water measurements notwithstanding, Great Western was draining the river dry, and that his most important client would be found out.37

Though Great Western may have had an outsized influence on the agriculture of the region, when it came to the need to maintain the water delivery infrastructure there was little difference between the responsibilities of the corporation and those of the typical farmer. The company used many of the same canals and so had a vested interest in keeping them clear of anything that might obstruct or limit the flow of water. In fact, Great Western’s water worries led it to take an outsized role. As their factories were built long after most neighboring farms were put to the plow, company factories tended to be near the end of the diversion line. This meant that farmers and flora took their full allotment—and sometimes more—before Great Western could obtain its share. Owing to water’s indispensable place in processing beets, Great Western often agreed to take full responsibility for maintaining entire ditches, even paying the full costs to repair ditches that had been compromised.38 When it came to refining sugar, Great Western was the only game in town, but when it came to obtaining water, the corporation was just another scrappy junior appropriator trying to keep its water source from drying out.

Great Western’s expansion eastward along the South Platte Watershed was fueled less by securing water rights and more by increasing water storage. From 1905 to 1907, the company built three factories, at Ft. Morgan, Brush, and Sterling, all along the main stem of the South

37 City of Loveland to J.R. McKinnie and J.F. Campion, 14 October 1900, Haynes to A.V. Officer 23 October 1902, 27 March 1903, 7 June 1903, 18 November 1903, 30 November 1903, 7 June 1903, 27 March 1903, 7 June 1903, 18 November 1903, 30 November 1903, Great Western Sugar Collection, Loveland Museum Archives, Loveland, Colorado (Hereafter GWS Loveland), Box 2.
38 Roy McCreery to Officer, 6 May 1904, GWS Loveland, Box 2.
Platte River. The majority of farmers in this region possessed less senior rights than their neighbors to the west, since farming had supplanted cattle ranching more recently in far northeastern Colorado. They relied primarily on return flows for their water. Return flows came from water that had already been diverted for agriculture at least once. Water that seeped from ditches and reservoirs, or percolated from over-watered soils, often trickled back into their streams of origin. According to hydrologists for Colorado Agricultural College (CAC) and the USDA, 137,000 acre feet of water returned to the South Platte Watershed from seepage alone, with a value to farmers of $2 million. To support the added water needs of sugar beet farming, farmers, boosters, and small towns financed the building of six new reservoirs to store these return flow waters. To support factories at Fort Morgan, Brush, and Sterling, as well as growers, Great Western financed and built Prewitt Reservoir to store 32,000 acre feet of return flow water at a cost of $700,000. The company determined that its factories would have to process 300,000 tons of beets per year from those three factories to turn a profit. The second-hand water from all of these reservoirs assured the company that, in most years, it could process every beet brought to its doors. Great Western’s manipulation of scarce water resources made its industrial operations possible; it also made them profitable.39

After refining beets into sugar, the work of water was not done. The same water that made Great Western and its growers profitable was employed to cleanse their industrial sins. Once Great Western processed beets into sugar and byproducts such as molasses and pulp for feeding cattle, it flushed the remaining wastes back into the South Platte Watershed. What were

39 Robert G. Hemphill and United States, eds., Irrigation in Northern Colorado; Ralph Parshall, Return of Seepage Water to the Lower South Platte River in Colorado, Colorado Agricultural College Bulletin 279, (Fort Collins, Colo: Agricultural Experiment Station of the Agricultural College of Colorado, 1922); J.C. Ulrich, “The Prewitt Proposition,” in the American Society of Civil Engineers Conference, Read for the Colorado Association of Members of the American Society of Civil Engineers, 11 January 1913.
those wastes? When laborers harvested beets, they simply knocked them together and threw them in a pile. Soil still clung to the beets when they arrived in the factories. That soil generally contained un-composted manure, bits and pieces of beet tops, additional soil additives, such as potash, and any number of microbes in the soil. Water under high pressure both cleaned the soil from the beets and washed it away. Once the beets were sliced – itself a water-intensive process – lime, coke, and coal were used to separate the usable sugar from the pulp and residue. Once these purifying agents had accomplished their tasks, processors flushed them from the factory as well. Workers then replaced the remaining pulp, which consisted of the fibrous portion of the beet from which sugar had been extracted, in fermentation tanks in advance of sending the pulp to farmers who used to feed cattle and sheep. However, Great Western expelled some of this pulp, along with residues of coal, lime, and a host of inorganic chemicals, directly into waterways. There, water was expected to perform its unending labors once more – this time to disperse, dissolve, and otherwise render inert the waste products of the sugar beet industry. But in many cases the sparse waters of a depleted and overtaxed watershed could not complete its allotted task.40

There is little evidence that Great Western concerned itself with the consequences of factory discharges in its initial fifteen years of operation on the Piedmont. Then, during its 1917-1918 refining campaign, the company ordered the supervisors of each of its factories to take water samples from parts of its operations.41 While supervisors took a few samples from the points where water was diverted from streams and reservoirs, most of the samples came from

40 See page 30-31 of this chapter for an in-depth explanation of why the waste dumped into streams by Great Western Sugar polluted streams and frequently killed fish.
41 It is possible that sporadic samples had been taken previously, but there is no record of them. Neither is it clear what precipitated this interest in factory waters, but it is possible it came from some sporadic complaints about odors emanating from the company’s operations.
inside factory walls. The process of refining beet sugar involves various stages of boiling and cooling, as well as placing contents under high pressure. Water regularly overflowed its containments and was discharged onto factory floors and down drains and sewage pipes. Heat turned liquids into gases which then fell to factory floors as liquid once again. During the process, factory workers added chemicals which often mixed with the liquids expelled by factory operations. Workers used sulfuric acid in the treatment of beet juices and molasses. Carbon was an essential ingredient in coal and coke, and Great Western used these to form the carbonic acid which fed the company’s boilers and helped to purify sugars. Though various salts clung to the beets that were transported to the factory by growers, salts such as calcium carbonate, and magnesium sulfate were also byproducts of sugar refining. So, it made sense that many volatile compounds – especially sulfuric and carbonic acids - and salts – especially calcium carbonate and magnesium sulfate - were present in elevated levels at every point of measurement in Great Western’s factories.\(^\text{42}\)

Based on Great Western’s factory figures, the company’s varied methods of waste disposal, and the technology available for measuring water pollution in 1918, it is difficult to determine the impact of the sugar beet industry’s pollution on the South Platte Watershed. Some of Great Western’s factories employed some sewage treatment before discharging its wastes. Factories like those in Greeley, Loveland, and Fort Collins emptied some of its wastes into settling basins where some of the solids suspended in water dropped to the bottom of the pond before the remainder was released into the Cache la Poudre and Big Thompson Rivers.

\(^\text{42}\) I examined sample results from factories at Longmont, Greeley, Loveland, and Fort Collins. The water sample reports are found in “Water Samples by Factory, 1917-1971,” Great Western Sugar Collection, Norlin Library, University of Colorado, Boulder (Hereafter GWS Norlin), Accession 3, Box 1. On the various chemicals, organic and inorganic – used during the refining of beet sugar see Robert Grimshaw and Lewis Sharpe Ware, The Sugar Beet: Devoted to the Cultivation and Utilization of the Sugar Beet (H.C. Baird & Company, 1910).
Greeley’s refinery ran its sanitary wastes through the city’s sewage treatment system. Factories in less populated areas, such as those at Eaton, Sterling, and Ovid, simply dumped all of their wastes directly into the Cache la Poudre and South Platte Rivers. In other instances, Great Western discharged its wastes into irrigation canals where they mingled with the wastes of farms. Even if company water samples provided specific data on each substance it discharged into the watershed, those figures would be of limited utility in 1918. Chemists were able to measure the quantity of organic and inorganic materials in water, and biologists could detect coliform bacteria in water (though precise measurements were not yet possible). However, it was not until the 1940s that scientists developed tests to measure how a watershed processed various organic and inorganic materials.  

These facts do not exonerate the sugar beet industry in 1918. Great Western had received sporadic complaints about unpleasant smells from its discharges. The company had received reports that the waters of reservoirs downstream of company factories were turbid, with froth and foam regularly accumulating on shorelines. Moreover, the very fact that the company limited its treatment of factory waste to areas with significant human populations provides strong evidence that it was aware that factory wastes caused pollution. In 1918, executives of the company received hard evidence that its factory wastes polluted the watershed.  

Concerns over factory wastes led Great Western to commission a watershed study that finally analyzed the impacts of the industry on the watershed. Conducted by University of Colorado biologist Max Ellis and two university graduate students in December 1917 and

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43 Descriptions of sewage treatment methods and facilities used by Great Western are from 1950; however, the company had done very little to alter its methods of waste disposal between 1918 and 1950. See Environmental Health Center (Cincinnati, Ohio), Missouri River Basin Project (U.S.), and United States, eds., South Platte River Basin Water Pollution Investigation: Report (Cincinnati, Ohio: The Center, 1950).

January 1918, the study examined streams and reservoirs directly impacted by factory wastes. Ellis and his assistants also obtained water samples from the head chemists at several company factories. The report was labeled “confidential” and delivered into the hands of Great Western’s executives on February 25, 1918.\textsuperscript{45}

The report is notable for its visceral descriptions of how Great Western’s discharges affected water quality and aquatic life. Ellis and his assistants first observed the Cache la Poudre River upstream of both the city of Greeley and Great Western’s factory. At that point, the stream ran clear, and the researchers found eight species of healthy fish including German Carp, Western White Suckers, Western Shiners, and Black Catfish, all indicators of a healthy riparian zone. Their second sample was taken within the City of Greeley, after the city dumped treated waste into the river – this included Great Western’s sanitary waste – but above the main discharges of the Great Western Factory. At this point, they found the river opaque, with only three living species of fish. Samples taken from below Great Western’s sewers revealed a “foul” and “turbid” stream where only two fish species remained, and researchers could only find fourteen fish in total. Later dissections of these fish found that their body cavities were filled with fresh beet shreds, and the water surface was colored with the lime cake waste used in purifying beet sugars. Further downstream, just beyond the point where the Cache la Poudre River emptied into the South Platte, Ellis made observations at a headgate that diverted water to Empire Reservoir, the most significant source of water storage in the area. They observed no living fish, but called attention to numbers of “carp at the headgate” floating in a foam that resulted from pulp waste being discharged from the Greeley factory. Following the canal to Empire Reservoir, they made observation at the inlet and outlet of the lake. At the inlet, they

\textsuperscript{45} Ibid.
observed that all of the fish were dead. In a rather evocative observation, they stated that “these dead fish were so abundant that a single cake of ice two feet square contained some fish, and another about 13 inches square contained over 20 small fish.” Ellis and his assistants described a kill zone at the inlet where they observed that the waters and the shorelines were devoid of the plankton animals, insects, and larvae that are the basic food of all freshwater fish. Using language farmers would be familiar with, they observed pulp waste frozen in the form of windrows along the edges of the lake. At the reservoir outlet, the researchers observed odd behavior. Carp and catfish were alive and plentiful, but they were constantly jumping out of the water; odd behavior for bottom feeders. In an understated tone, Ellis stated that such behavior suggested that these waters were “at least slightly impure.” It was not for two more decades until biologists could explain the behavior of these fish. Organic wastes from beet sugar processing, especially pulp waste, were consuming all of the oxygen in the reservoir, suffocating all of the reservoir’s life – including its fish.

Observations at Fossil Creek Reservoir yielded many of the same findings, but its water sources offered scientific conclusions not afforded by Empire Reservoir. Fossil Creek Reservoir received its waters from two sources. The first was Fossil Creek, a waterway that had not been dammed or diverted prior to flowing into the reservoir. The other source was the Fossil Creek Ditch, which possessed an intake located on the Cache la Poudre River, downstream of Great Western’s factory at Fort Collins. The water from the latter source yielded predictable results. The researchers described “hundreds of dead carp and suckers and thousands of (dead) black-headed minnows.” Describing the macabre scene, they stated “all of the fish were covered with

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46 Tests for measuring the oxygen in a stream needed to dissolve organic pollution, called Biochemical Oxygen Demand (BOD), were developed in 1940. Though Ellis correlated fish deaths with sugar beet wastes and even witnessed fish gasping for air, no tests yet existed to show exactly why sugar beet waste caused fish death.

masses of heavy slime, which hung in festoons from the fins and gills.” Excavating their stomachs, the researchers observed that the dead fish had not eaten in 36-48 hours. While the work of death had been completed in most of the reservoir, the intake from the pure waters of Fossil Creek told a different story. There the dead fish mingled with the living as the researchers observed fish attempting to position themselves to receive the oxygenated flow coming from the creek. Little did they know that attempts to survive were futile, since beet sugar sewage had worked its way 250 yards upstream and was slowly choking oxygen intake.48

Ellis and his assistants sought explanations for their field observations by performing lab experiments. Taking water samples from various factories as well as from Fossil Creek Reservoir, they subjected the same species of living fish to beet sugar wastes in a variety of concentrations. Fermented beet pulp proved to be the most lethal. Great Western discharged the pulp into the river from its silos, as well as from its settling basins. Experimenters placed fish in various solutions of pulp waste from full strength to .10%. In the full solution, all fish were dead in two hours, while in the most dilute solution, all died within eight days. In a fatal irony, fish were in much less danger from beet waste discharged directly into the river than sewage deposited in the settling basins that were meant to cleanse company sewage prior to discharge into the stream. The relatively fresh water of streams contained few of the toxins present in settling basins, where acids used in the factory mingled with beet wastes to produce a toxic brew. Researchers offered strong anecdotal proof of settling basin toxicity when they immersed fish in weak acid solutions that slowly killed fish. Regardless of the solution used, the clinical picture of dead fish in the lab mirrored that of fish in streams and reservoirs. This time, however, under laboratory-controlled conditions, the researchers had a closer view to the killing process.

48 Ibid, 7-10.
Describing the mucous that developed on the fish, they observed that it first formed over the eyes, then appeared in irregular spots on the fins until it covered the entire body. Eventually the mucous was so thick that “it would be peeled off the body of the fish in strips.” Though not nearly as lethal, researchers exposed fish to concentrations of lime, similar to that used in the factories. In high concentrations it killed all fish, but in lower doses, most fish survived. As a non-toxic mechanical irritant, lime only killed when fish gills became clogged with the mineral and were unable to expel it. Finally, experimenters placed fish in salt solutions in the same quantities as those found in factories, and the fish appeared unharmed after nine days.49

Ellis and his researchers came to several conclusions that help to quantify the South Platte Watershed’s ability to do the cleansing work industrial agriculture required of it. Samples of acid concentrations on the floor in Great Western’s Eaton factory were judged to be 3,000 times stronger than the solution of acid used by experimenters that killed all fish in eight days in the laboratory. Using that metric, they determined that a flow of 108,000 cubic feet of water per hour was needed to achieve a “dilution equal in strength to that killing fish in eight days.” Broken down into the language of irrigators, that meant that a flow of 30 c.f.s. could purify a stream enough so that fish could live as much as eight days. For fish in Piedmont streams, the odds of achieving that flow in the average year were marginal at best. For example, in the 1890s, before Great Western was withdrawing water for its factories, winter flows during November – typically the first month of beet processing – averaged less than 30 cfs in two out of the three years for which there is data.50 Flows on larger streams such as the Cache la Poudre and South Platte were higher, while flows on the St. Vrain, where the Longmont factory dumped its wastes, were lower. If fish lived dangerous winter lives in Piedmont streams, they were under

49 Ibid, 11-25.
50 Field, Irrigation from Big Thompson River, 13.
a sentence of death if they meandered into the irrigation ditches and reservoirs fed by Great Western’s discharges. There, flows were negligible at best.51

Wastes from the Piedmont beet sugar industry offer a case study in the limits of water’s labors. Great Western and its growers required more work from the region’s water than it was capable of performing. In the rush to grow the most lucrative crop in the region, farmers and factories squeezed ever greater quantities of water from rivers. By depleting streams of their flows, Piedmont agriculture also constricted their ability to dilute wastes. Having weakened streams of their sanitizing qualities, the company proceeded to contaminate its weakened ally. Prior to 1918, how much company executives understood about the consequences of its pollution is debatable. That year, the eyes of company executives were opened. Whether the report circulated after that year is not clear. Regardless, the company changed little about how it discharged its wastes for the next thirty years.

Great Western’s greatest allies in maintaining business as usual were cultural values and public ignorance. While residents who lived in Piedmont towns occasionally complained of the smells emanating from factory wastes, their concerns rarely amounted to any concentrated action as Great Western contributed more employment and money to the Piedmont economy than any other company. Further, few people in the region cared much about carp, suckers, and dace – fish that few people angled for or valued. Commonly referred to as “trash fish,” these native species commanded little attention, dead or alive. Ironically, many of the most desired species of the Piedmont Watershed were non-native. Planted in the headwaters of the South Platte Watershed in places such as Rocky Mountain National Park, exotic rainbow and brown trout attracted tens of thousands of sportsmen during the same decades when native fish were being

decimated on the Piedmont. Had those sport-fish been threatened by the beet sugar industry, watershed protections likely would have ensued. But the economic value of the Piedmont was rooted in agriculture, not sport-fishing.

Lack of public interest in the polluted South Platte Basin held up further study of the sugar beet’s impact on the watershed. Finally, in 1950, as growing residential populations on the Piedmont were spreading into agricultural areas and scientists developed more precise means for measuring water pollution, agencies of the state and federal government and the city of Denver collaborated on an investigation of water pollution in the South Platte River Basin. Ten years earlier, biologists had developed a test that measured the biochemical oxygen demand (B.O.D.) in water. This measured the amount of dissolved oxygen demanded by biological organisms – such as fish - to break down organic material at a specific temperature over a given time period. Organic materials, including crop wastes and sugar beet pulp, require dissolved oxygen to degrade in water. By dumping sugar beet wastes directly into the South Platte Watershed during the winter months when its factories were in operation, the company placed excessive oxygen demands on Piedmont streams. Since its development in 1940, BOD has been the most valuable determinant of water pollution. The 1950 study revealed that the beet sugar industry contributed five times more organic pollution to the watershed than any other source. Yet, only one of Great Western’s factories provided any treatment that substantively reduced that pollution load. Even more revealing, the study used a new metric called population equivalents (PE), which compared the waste pollution from a particular source to the mean waste pollution produced by the average person. The study concluded that, during the three months when Great Western refined beets

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52 On sport-fishing in Rocky Mountain National Park, see Jerry J. Frank, Making Rocky Mountain National Park: The Environmental History of an American Treasure (Lawrence, Kansas: University Press of Kansas, 2013), 143–70.
into sugar, it discharged the daily raw sewage equivalent of 4.1 million people. At the time, only 600,000 people lived on the Piedmont, and that included the city of Denver. Those eye-popping figures placed Great Western and the beet sugar industry in the region under the public microscope, and forced them to upgrade their facilities. But if we read those figures into the past, we see that the sugar beet industry had been placing an overwhelming burden on the South Platte Watershed for many decades before 1950 – and they were well aware of it.53

As the public face of the beet sugar industry on the Piedmont, Great Western Sugar would be easy to blame for the persistent pollution of the South Platte Watershed. Certainly, the company was culpable for its failure to address Ellis’s research in any substantive way. However, when we step back and examine the issue from the vantage point of water and irrigation, culpability embraced a much wider set of actors. Great Western took precious little ownership over the lands and waters employed by its growers. As Home Supply and its stockholders illustrated, irrigators devoted much time and money to squeeze as much water from the system as possible. And, when it came to moving water, they expended almost every last dime to feed water into canals and ditches rather than drain it back into the watershed. What little effort they employed to return water to streams came indirectly - as a result of flooding fields through over-irrigation, or because junior appropriators downstream required return flows for their livelihoods. Further, farmers and their mutual irrigation companies understood that sugar beet agriculture required more water long before Great Western built a single factory. Growers and irrigation engineers understood that developing a system to move water onto the bench lands above rivers required more engineering, longer canals and ditches, and therefore more money. Since that water was more expensive, farmers became increasingly wedded to

53 South Platte River Basin Water Pollution Investigation, 9-123.
sugar beets – the most lucrative crop in the region. But, none of them – farmers, irrigation engineers, Great Western Sugar - stood to gain much from reinvigorating the watershed that was the source of their livelihoods. Profit informed farming and sugar processing, and the South Platte Watershed was managed as a factor of production. What mattered to users was its availability and quality at the time it was used. They applied little care for the resource once it flowed away. Consequently, water users engineered their system for efficient production with little thought of adequate disposal. Through their diversion efforts, they participated in the work of water to grow crops and process them into food, while leaving the little water that remained to do the clean-up all on its own.

Between 1900 and 1930, that workload was increasing. Not only did sugar beet agriculture increase its demands for water diversion and storage, but farmers put more acres under the plow…and the ditch. As irrigated agriculture grew in the American West, Colorado often set the pace. Between 1900 and 1920, the state led the nation in irrigated acres, and the Piedmont dominated irrigated agriculture in the state. In 1930, the South Platte Watershed boasted 1.4 million irrigated acres, 40% of the state’s total. Where water flowed, so did money. The value of water rights for irrigation from the Cache la Poudre averaged $400 apiece in 1880, and $4,500 in 1917. Lands with excellent water rights, such as those near Greeley, had escalated in value as well. By 1922, land near Greeley was going for more than $300 per acre. Back in 1870, $300 could buy eighty acres in Union Colony lands. While numerous factors played roles in land value escalation, water was prime among them. According to the Fort Morgan newspaper, when local boosters and farmers combined forces to build Jackson Lake in 1904, “application of the lake water had almost a magical effect upon land values. Land(s) that had been offered for $50 per acre the previous year doubled (in value) almost overnight, and have
continued to rise…” As long as river diversion generated wealth, and additional water could be squeezed from Piedmont streams without arousing widespread concern, farmers, boosters, cities, and industry would engineer systems to deliver it.\textsuperscript{54}

That need to deliver water in increasingly complex ways placed heavy demands on engineers. Unfortunately, water engineers are largely background figures in discussions of irrigated agriculture. That is a significant oversight, especially on the overtaxed Piedmont landscape, where their work was far from routine. Irrigation experts were responsible for designing the systems that enabled bench lands above rivers to be watered. These comprised most of the irrigated acres on the Piedmont by the early twentieth century. They were responsible for siting and building reservoir storage. Irrigation engineers developed methods for draining waterlogged lands, and estimated how much water was returning to the watershed for use downstream, measurements that were crucial before water rights could be granted to new appropriators. Knowledge of Piedmont irrigation even vaulted some onto the political stage, a fact illustrated by Elwood Mead, Colorado’s first professional irrigation engineer and a significant figure in early twentieth-century reclamation legislation.\textsuperscript{55} Perhaps the least valued aspect of their work is measuring water. By the 1920s, measuring water offered one of the few methods left to disburse an abused and scarce resource.

During the 1920s and 1930s, Ralph Parshall, an irrigation engineer at CAC, developed measurement techniques that vastly increased the efficiency of water distribution in the South Platte Watershed and, as a consequence, gave him a platform to influence some of the most


important water decisions of his time. Parshall was born in 1881, and grew up in Golden Colorado, near the banks of Clear Creek, one of the tributaries of the South Platte. He entered CAC in 1899, majoring in civil engineering. His passion for hydraulics led him into the relatively new field of irrigation engineering. Coming from a family of farmers, he grew and harvested potatoes in the summer. During the sugar beet boom, Parshall picked up part-time work as a mechanic and pipe fitter for the Fort Collins beet sugar factory in 1903. After graduation, Parshall spent several years working in the Colorado State Engineer’s Office where the state’s various systems of irrigation occupied much of his time. After graduate work at the University of Chicago, Parshall was hired by CAC as an assistant professor of civil engineering in 1909. While there, he was also employed by the USDA’s Division of Irrigation, Soil Conservation Service, where he became director of the program in 1918, a post he held for thirty years. Parshall helped to plan and build CAC’s hydraulics laboratory, where dams and irrigation structures on the Piedmont and throughout the irrigated West were tested and modeled.\textsuperscript{56} With his background in farming and irrigation engineering, and with his connections to engineers at the state and federal levels, Parshall was equipped to diagnose the weaknesses within the Piedmont’s irrigated agriculture and trained to develop technical solutions.\textsuperscript{57}

According to Parshall, the most significant problems facing irrigators on the Piedmont revolved around inefficiency. As Parshall surveyed how water was employed throughout the region, he observed that humans failed to manipulate water as they should, and he concluded that technocratic solutions were necessary in the engineering of water and in its governance. In 1922,

\begin{itemize}
\item \textsuperscript{57} Ralph Parshall, \textit{Return of Seepage Water to the Lower South Platte River in Colorado}, Bulletin 279 (Fort Collins, Colo: Agricultural Experiment Station of the Agricultural College of Colorado, 1922); Parshall to C.P Gillette, 30 April 1925, Irrigation Research Papers Box 5; “Third Conference on Irrigation,” Irrigation Research Papers, Box 5.
\end{itemize}
Parshall provided one of the first complete expositions of water seepage in the region. His research showed that 30% of all the water withdrawn from the watershed returned back to it as a result of seepage. In financial terms, Parshall calculated that this water was worth $2 million annually. According to Parshall, Colorado farmers should be alarmed that so much of this water flowed out of the state into Nebraska when the system could accommodate more downstream reservoirs. Parshall measured water efficiency in quantities of crops as well as money earned. In advocating for two new dams on the Cache la Poudre River in 1925, Parshall’s metric was sugar beets, stating that these dams would provide the necessary water to grow two additional tons of beets per acre. Elsewhere, Parshall complained that reservoirs were notoriously leaky, losing half of their water to seepage and evaporation, implying that farmers could have more secure water supplies if only they invested more money – through their irrigation companies - in the modern engineering necessary for delivering this precious resource. If water draining from creaking structures presented one kind of inefficiency, then water that failed to drain presented another. Parshall pointed out that plenty of good farmland was out of production because farmers either applied too much water to their lands, or water seeped onto their lands from neighboring farms. Better drainage could add more water into the system, and it involved the simple technique of installing underground tiles to divert water to the nearest waterway. For Parshall, engineered solutions, many of them quite simple, would alleviate the Piedmont’s water woes and foster a more productive and lucrative agriculture.

Then why were these solutions not employed more consistently? For Parshall, much of the answer lay in what he viewed as outdated business practices. He decried what he saw as the “lax and crude methods” characteristic of mutual irrigation companies. According to Parshall, addressing problems such as seepage in leaky reservoirs and ditches, draining flooded farmland,
and building new storage to corral return water were all primary responsibilities of irrigation companies. Parshall opined that these companies lacked the foresight to plan for their water futures, and consequently were unwilling to invest the money necessary to upgrade their aging systems. Moreover, Parshall argued that mutual irrigation companies were “managed by men with limited business experience” who “lack aggressiveness and individuality of purpose.” Believing that effective management required centralized control over irrigation waters, Parshall argued that “it will be necessary to combine several units into a common organization and operate the federated systems under efficient management.” Parshall further stated that, as the region’s population continued to increase and the demand for water with it, irrigation management would need to be run by a group of specialists with business acumen, implying that small irrigation companies led by farmers/stockholders were incapable of managing water effectively.  

While Parshall never advocated vesting these powers in agents of the state directly, his belief that resources such as water should be managed by a group of specially trained experts reflected his support of progressive ideals. Though not trained by Elwood Mead, Parshall’s viewpoints reflected Mead’s desire to employ public science to manage water more efficiently. In describing some of the same inefficiencies in water management in 1903, Mead argued, “if the water of streams is public property, the public should show the same business ability in disposing of its property as those to whom the control is transferred.” By that philosophy of conservation, resources should be put to their highest use and not wasted. Leaky reservoirs, failure to use flows that returned to streams, unbuilt storage, and water flowing out of the state untapped by farmers were all examples of waste in the system. According to Parshall,

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58 Parshall to Gillette, 30 April 1925, Irrigation Research Papers, Box 5.
centralized management of water resources by irrigation experts would plug many of the gaps left by poor management.

Parshall’s faith in technocratic expertise also helps to explain his particularly instrumental view of rivers. As a water engineer, Parshall’s work drew fairly clean lines between conservation and preservation. When evaluating a river, he was concerned with its ability to supply water for people in perpetuity. Water unappropriated for human use was water wasted. Further, the highest and wisest use occurred when the same water could be employed on multiple occasions, which is why Parshall valued return flow so much. It also explains his disdain for the management practices of mutual irrigation companies. By allowing so much water to be lost to seepage, poorly measured allocations, and ditch-side vegetation that gulped the passing flow, Parshall believed that these water managers were not just incompetent but also poor conservationists. Parshall did not value river water for its mere existence in the stream, for its support of flora and fauna, or for its ability to create esthetic beauty. Those were desirable only insofar as they supported a resource that could be renewed and re-used in perpetuity. Moreover, as an engineer, his primary interaction with water occurred after it had been drawn from streams, when it flowed through engineered channels and into constructed lakes. The pre-eminent value of a watershed was in its ability to deliver water efficiently and in sufficient quantities. As an irrigation engineer, his primary purpose was to make a watershed yield the greatest quantity of usable water. And the highest praise Parshall could give to water managers was that they wasted not a single drop of the resource they were entrusted with.

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Parshall’s greatest contribution to efficient water management came from a device he invented with the help of graduate students at CAC. Eventually named after him, it was called the Parshall Flume, and it revolutionized the measuring of water in canals and ditches and, as a consequence, made water diversion more equitable. As Parshall saw it, the single most significant barrier to efficient water management was measurement. He argued that at least 25-30% of water was unavailable to junior appropriators due to measurement inaccuracies that enabled senior appropriators to take far more that their legally allotted share of water. Parshall further argued that only one-quarter of all water in the South Platte Watershed was measured accurately as late as the 1920s. The most common devices at the time used to measure water volume and flow were the weir - generally installed at diversion dams and in canals and ditches - and the rating flume - more commonly placed in streams. Both devices were situated in waterways and calibrated to measure the volume of water passing a particular point based on a known flow and the depth of water in the channel. This enabled irrigation companies to measure the water passing through their main canal, into their reservoirs, and through the ditches that carried water directly to farmers. Unfortunately, the devices were only known to be accurate at the moment of installation. In his numerous writings, speeches, and radio addresses, Parshall harped on how changing conditions caused gross misreadings. Conditions upstream of weirs and flumes altered depth and flow. Gravel and sand might build up in a particular spot, and tree branches and debris clogged waterways, causing water to pool at greater depths in one location, while causing it to flow swift and shallow in others. Any of these would hinder accurate gauge readings. The floors of the flumes and weirs themselves were problematic. Irrigators placed the devices in a level spot on channel floors so that depth could be accurately measured. This presented particular problems when sand and gravel accumulated on the flume. As this
happened, the gauges misread the depth of the water, leading water managers to conclude that there was less water in the channel than in reality.\textsuperscript{61}

In 1921, Parshall and his students claimed to have solved that problem through what they originally called the Improved Venturi Flume (though not named after Parshall until 1930, I will refer to these flumes as Parshall Flumes). Parshall capitalized on the previous work of hydrologists who had determined that there was a unique relationship between the depth of water and its flow. In streams where water slows and appears to stagnate, deep pools are often formed. At the downstream end of that pool, the flow increases and the stream becomes shallow. Hydrologists had identified what they called “super-critical flow,” the point where water transitioned from slow and deep to fast and shallow. They also identified a critical depth at which that flow could be measured. Parshall and his students sought to develop a flume that could generate super-critical flows in irrigation ditches. These flows were ordinarily not possible in irrigation waterways since engineers and farmers dug their ditches with minimal slope. This resulted in slow-moving waters that were ideal for delivering water but not for measuring it. To solve this, Parshall placed his flume on the floor of irrigation canals and ditches, across their entire width. Water entered the flume and converged into a narrow section called the throat. In the throat of the flume, Parshall introduced a downward slope significant enough to replicate the super-critical flow found in natural streams. He then installed a water gauge at the critical point to measure its volume. Water then emerged out of the throat and eventually back into the channel. The flume effectively solved the problem of upstream obstacles. As long as super-critical flow could be introduced within the flume, upstream conditions might impede water but

not its measurement. The Parshall Flume also minimized complications from debris within the flume itself. Super-critical flow generally introduced enough force to clear obstacles that might otherwise accumulate on the flume floor. According to tests made by Parshall and his students, this new innovation had an error factor of less than 3%. If Parshall’s estimates were correct, this breakthrough could make 20% more water available to junior irrigators in the South Platte Watershed by preventing senior appropriators from taking more than their allotted share. By 1927, the Parshall Flume was already being used in Hawaii, Canada, Central and South America, and Africa. Yet most irrigation companies on the Piedmont were not rushing to upgrade their aging systems.62

Why not? The answer is found more in the practical politics of water than in its engineering. Stockholders in irrigation companies received their water allocation based on measurements in ditches and canals. Since older technology often registered flows that were lower than the reality, irrigators were actually receiving more water than these outdated gauges showed. Installing new Parshall Flumes would require ditch companies to collect money from its stockholders for the installation of devices that would likely reduce their allocation of water. Further, when it came to their most important resource, farmers and their irrigation companies did not wish to invest money on new technology, especially when it might curb their water allocations. As irrigation engineer Chris Thornton pointed out, “there is something inherently conservative in ditch companies; they don’t want to spend money and they don’t want to mess with (their water).” As long as they received their water, farmers had little interest in altering the system that delivered it to them.63

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62 Parshall, “Improved Venturi Flume”; Interview with Chris Thornton; Parshall, 14 March 1932, Parshall Papers, Box 1, KOA Radio Talks.
63 Thornton Interview.
The failure to quickly integrate these new flumes into Piedmont agriculture figured heavily into Parshall’s crusade for efficiency and in the specifics of his message. From the late 1920s through the 1930s, Parshall was a regular guest on the radio station, KOA. Nicknamed “the blowtorch of the West,” KOA broadcast radio shows throughout the Piedmont. Since Parshall grew up farming irrigated lands in Northern Colorado, he understood quite well how to appeal to this target audience. During several interviews, Parshall argued that accurate water measurement would result in better farmers. Pointing out that too much irrigation could often be just as detrimental to a crop as too little, he stated that Parshall Flumes would enable farmers to know exactly how much water they were applying to their crops, facilitating better harvests and more wealth. Speaking to the junior appropriators in the region, he called attention to their stresses over water scarcity, stating that better measurement would result in more water security since senior appropriators could not take more than they were allotted. He also appealed to the time and money saved through technical improvements, arguing that the supercritical flows generated by the Parshall Flume made it effectively self-cleaning, saving the time and money usually needed to clean debris from ditches. Parshall tugged at notions of fairness and logic, arguing “it is just as reasonable to have one’s water measured as measuring one’s crop for sale.” Throughout all of his broadcasts, Parshall played the role of educator, explaining how his flume operated, hoping for converts amongst those who doubted its engineering or were repelled by their own lack of installation know-how. Parshall had long been a champion of technocratic efficiency. The radio offered him the platform to broadcast his ideas.64

While Parshall continued his public relations campaign through the 1930s, he shifted his research focus from the ditch to the river. Recognizing that ditches pull more than just water

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from streams, he experimented with devices that could divert sediment away from the headgates that pulled water into canals and ditches. Parshall argued that, even though his flume was capable of clearing out sand and silt, those same substances accumulated in ditches, costing irrigation companies upwards of $1,000 each week if they were not removed. In addition, despite the popular perception that silt applied to farmland functioned as a fertilizer, Parshall argued that the amount delivered through irrigation works was more harmful than beneficial. In cooperative experiments between CAC and the USDA Bureau of Agricultural Engineering, he made several attempts to install what he called vortex-tubes and riffle deflectors into river channels upstream of headgates. These were supposed to divert unwanted debris into sluices that could then permanently remove the offending material from the path of the headgate. Parshall also participated in ongoing snow surveys, using instruments to measure the depth and water content of snow in the mountains at evenly spaced intervals. He then developed new algorithms to determine how the snowpack translated into water available for irrigation in the South Platte watershed. Enthusiastic about the utility of these surveys, Parshall told KOA listeners that snow survey results were useful also for municipal water managers, the hydro-power industry, and for bankers as they might evaluate agricultural loans and investments based on the power of water to generate enough revenue to make their investments pay. Parshall also theorized that plentiful tree cover in the mountains would result in a more prolonged run-off in May, June, and July. So, he enlisted CAC students in initiatives to plant trees at various critical points in the mountain areas of the watershed. In all, Parshall sought an engineered, managed watershed, capable of delivering plentiful water, in measured amounts at predictable intervals.65

65 Parshall, 1 May, 6 September, 11 September, 1933, 9 April 1935, Parshall Papers, Box 1, KOA Radio Talks, 1931-1935; Parshall to Gillette, Irrigation Research Papers, Box 5.
Evaluating Ralph Parshall’s impact requires the use of differing metrics. As an engineer, Parshall has had a great impact. In the long-term, the Parshall Flume was a resounding success. Worldwide, variations on it remain the standard for measuring water in a ditch or canal. And, Parshall’s reputation as a steward of the public good has grown exponentially. Since neither he nor CAC ever attempted to patent the design (though Parshall did patent the measuring gauge inside the flume), it could be reproduced cheaply. However, during his own time and on his own turf, the Parshall Flume was only slowly adopted on the Piedmont, and usually not as a result of his logical and impassioned crusades. The simple fact was that irrigation works designed around 1900 or before were wearing out, and irrigation districts slowly conceded that they would suffer financially if they did not upgrade. In the case of Home Supply, the company installed Parshall Flumes throughout their system beginning in the late 1950s when the federal government made attractive loans available to upgrade crumbling infrastructures. Their neighbor and competitor, Louden Ditch Company offered a similar story. The snow surveys supported by Parshall have become commonplace in watersheds throughout the world, though Parshall’s input would likely be a footnote, since thousands of researchers participated in their development. As for devices used to divert sediments from irrigation headgates, his efforts were unsuccessful as these devices were constantly being dislodged and obstructed in streambeds and were too costly to repair and replace. However, engineers who followed Parshall successfully adapted these devices for use in irrigation ditches. Parshall’s push for more technocratic, efficient, and centralized control over the Piedmont’s water resources largely failed as well. Power over the distribution of water remained vested in many small mutual irrigation companies who remained more concerned over whether they possessed sufficient water than whether that water was efficiently managed. While

centralization may have resulted in more water rights fulfilled in the system, as Parshall argued, those who already possessed access were loath to relinquish control.

While Parshall struggled to gain converts for his gospel of efficiency on the Piedmont, he had little trouble finding those who simply wanted more water. In the tension between technocratic efficiency and decentralized control, all sides agreed that irrigating the arid landscape demanded more water. During the 1930s, farmers obtained it by tapping into federal government programs to exploit distant water sources. Their method was called trans-basin diversion. Simply put, it involved moving water from one watershed into another. Of course, it was not that simple because moving water between basins required forcing water to flow uphill before it could flow downhill. Hence, engineers had to manipulate the landscape to accommodate the unnatural act. In truth, trans-basin diversions were nothing novel in the 1930s. The 1882 Colorado Supreme Court decision, *Coffin v. Left Hand Ditch Co.*, established the legality of such projects. The largest of these, The Grand River Ditch, transported water in an unlined ditch and wooden flumes to Fort Collins through an area that would eventually be added to Rocky Mountain National Park. By the early 1930s, there were several trans-basin projects that reversed the flow of waters from the wetter west slope of the Continental Divide to the arid east slope. In all, these projects accounted for more than 30,000 acre-feet of water, enough to provide sufficient irrigation to grow 12,000 acres of beets in an average year, or 7.4% of the total
number of acres in beets in 1936.\textsuperscript{67} This was more than a drop in the bucket, but it was not enough to meet the demands of Piedmont farmers and industry.\textsuperscript{68}

Nature, politics, and economics conspired in the mid-1930s to resurrect a trans-basin project that transcended all previous efforts in scale and scope. Eventually called the Colorado-Big Thompson Project (C-BT), it tapped into Grand Lake, Colorado’s largest natural body of water. Grand Lake is situated directly west of the Continental Divide from the major farming and population centers of the Piedmont. Operating as a catch-basin for the headwaters of the Colorado River, Grand Lake’s waters were coveted by Piedmont farmers, boosters, and irrigation companies at least as far back as 1904. However, the lake was situated at just over 8,000 feet in elevation and the range of mountains arrayed between it and the Piedmont hovered at a lofty 13,000 feet. Consequently, moving the water required boring through miles of rock, bringing into question the cost of such a project and whether engineers could accomplish the Herculean feat. Farmers, local boosters, and Great Western Sugar revived the project in 1933 as crop prices plummeted on the Piedmont and drought constricted the region’s water supply. Based on preliminary estimates, early advocates projected that 285,000 acre-feet of water could be added annually to the Piedmont’s water supply through such a trans-basin diversion.

Five separate Piedmont counties and cities as well as Great Western Sugar lined up behind the idea. They formed the Grand Lake Committee and pooled their monies to fund a feasibility study. In 1934, the federal Bureau of Reclamation agreed to conduct engineering

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\textsuperscript{67} The typical water requirement to grow an acre of beets in Colorado in the mid-1920s was between 2 and 2.5 acre feet. Experiments in the early 1930s suggested that yields would increase with slightly more water. Thus, I calculated water requirements for an acre of sugar beets at 2.5 acre feet. During 1936, farmers on the Piedmont contracted to grow 162,000 acres. See TTL (January 1936): 3; Samuel Fortier, “Irrigation Requirements of the Arid and Semiarid Lands of the Missouri and Arkansas River Basins,” \textit{USDA Technical Bulletin 36} (Washington: U.S. Government Printing Office, 1928), 29.

\textsuperscript{68} Christine Pfaff, \textit{The Colorado-Big Thompson Project Historic Context and Description of Property Types} (Denver: Bureau of Reclamation, 1999), 76-87; Tyler, \textit{The Last Water Hole}, 3.
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studies in advance of a project proposal. The federal Public Works Administration then provided $150,000 to complete it. Over the next three years support for the project emerged from a variety of sources, including all but one member of Colorado’s Congressional delegation, editors of all of the newspapers on the Piedmont, a majority of local, elected officials, mutual irrigation companies and their farmers/stockholders, and academics such as Ralph Parshall.69

Two major hurdles stood in the way of this massive project. The National Park Service (NPS) initially blocked federal surveyors from entering Rocky Mountain National Park, arguing that their work constituted a commercial violation of the park’s mission to preserve natural and scenic values and that the project would drive away tourists. However, since the 1915 act that created the park contained a clause that allowed for reclamation projects, NPS eventually backed down in exchange for the rights to free power from the hydroelectric features of the water project and a guarantee that no future federal reclamation projects would be allowed in the national park. Edward T. Taylor, Colorado’s lone congressman from west of the Continental Divide, also objected, arguing that a trans-basin diversion stole water from his constituents. As an influential and long-time member of the House Appropriations Committee, he could effectively withhold funding for the project. C-BT proponents eventually placated Taylor by agreeing to build a 150,000 acre storage reservoir west of the divide and placing it first on the construction docket. Called Green Mountain Reservoir, it would effectively replace some of the water lost to the C-BT by adding additional water storage on the west side of the divide.70

Approved by Congress in 1938 and finally completed by the Bureau of Reclamation twenty years later, the C-BT was a costly engineering marvel that eventually added 320,000 acre feet of water to Piedmont supplies. Put in perspective, that bolstered Piedmont water supplies by

70 Tyler, The Last Water Hole, 26-57.
20%, the equivalent of doubling the entire average annual flow of the Cache la Poudre River. To bring the water to the eastern slope of the Rockies, engineers siphoned it from the Colorado River through four dikes and stored it in the massive 540,000 acre foot Granby Reservoir. They then pumped it nearly 200 feet uphill into the much smaller Shadow Mountain Reservoir, also constructed for the C-BT. Behind Shadow Mountain Reservoir, engineers constructed a channel to move water into Grand Lake. The water then entered the Alva Adams Tunnel just one-quarter mile outside Rocky Mountain National Park, emerging 300 feet east of park boundaries 13.1 miles later. From there, engineers diverted water into the Big Thompson River, as well as into a series of dams, tunnels, and canals. Eventually the water plunged 2,900 feet and through nineteen additional dams until it flowed into the irrigation canals of farmers on the Colorado Piedmont. Though primarily intended as an irrigation project, the C-BT also supplied power and municipal water to Piedmont communities, including Boulder, Longmont, Loveland, Fort Collins, and Greeley.\footnote{Robert Autobee, \textit{Colorado-Big Thompson Project} (Denver: Bureau of Reclamation, 1996), 17. For a list of C-BT features, including construction dates, see Christine Pfaff, \textit{The Colorado-Big Thompson Project}, 76-87.}

Voices that united behind the C-BT on the Piedmont rallied around the economic value of increased water set against fears over the consequences of its scarcity – arguments that would have sounded quite familiar to water users back in 1900. As Colorado’s resident expert on irrigation engineering and a well-respected public figure, Ralph Parshall was enlisted by the USDA’s Department of Agricultural Engineering and CAC to research and write a report on the benefits of the C-BT. They published the report in January 1937. Parshall, aware that a massive reclamation project might be viewed as a government handout to wealthy farmers in the midst of the Depression, characterized the farmers on the Piedmont as “hardy, self-reliant American farmers and townspeople” who needed additional water to “stabilize the present economic
achievement and make secure the possibilities of future progress.” In a nod to popular New Deal programs, Parshall stated that the guarantee of sufficient water would be like “social security” for existing farmers, enabling them to gain the same security in their later years that working class Americans were beginning to realize. Seeking to demonstrate that the C-BT was a difference-maker, Parshall argued that its greatest value was that its flows would be available late in the growing season, when junior water users often ran out of water and when an additional application of water to high value crops such as sugar beets and potatoes might make the difference between a modest profit and debt. In stark financial terms, Parshall stated that irrigation provided $64 million worth of property value to the Piedmont, a region valued at $200 million. This additional property value resulted in local, state, and federal taxes that could be invested in schools, infrastructure and economic development. Knowing that C-BT detractors might argue that the nation was suffering from too much agricultural production, Parshall turned that caution on its head by claiming that more water would shift agricultural production away from crops grown in surplus and toward crops not grown in sufficient quantities. For example, he argued that wheat, whose national supply had far outstripped its demand, was a crop of choice on the Piedmont only when water was in short supply. By contrast, domestic sugar beets, which demanded more water than wheat, supplied less than 50% of the nation’s sugar demand. Consequently, according to Parshall, increasing Piedmont water supplies would push farmers to grow more beets and less wheat, thus aligning the nation’s agriculture more closely with consumer demand. This was a tendentious argument in 1937, since sugar beet acreage was based on an acreage quota system, adjusted annually by the Secretary of Agriculture. However, there was some accuracy to Parshall’s conviction that more water would supply more beets since
studies in the 1930s revealed that slightly more water yielded larger beet yields.\textsuperscript{72} Parshall concluded that more water on the Piedmont resulted in self-reliant, productive Americans who created real economic value in their region and beyond. In other words, the C-BT was an overwhelmingly good investment.\textsuperscript{73}

While Parshall was an unqualified supporter of the C-BT in 1937, he left out any mention of water inefficiencies on the Piedmont in favor of a narrative that left no doubt as to region’s water needs. Until 1937, Parshall had built his engineering career around shoring up the cracks in the South Platte’s irrigation infrastructure. Fixing dams, controlling seepage, measuring water, surveying snow, and removing silt were all attempts to make the most use of water that was already within the watershed. His research and advocacy, prior to the advent of the C-BT, emphasized that a watershed was a sealed system, and that the goal of the engineer was to create as much utility as possible within that system. In fact, in the early 1930s, he generally tried to redirect conversations about trans-basin diversion.\textsuperscript{74} In his mind, reversing water’s flow during the Depression would result in costly water that farmers could not afford. The best answer was found in efficient use of the watershed. However, by the time the idea of the C-BT entered broad Piedmont consciousness, Parshall had witnessed the slow progress of his flume and the failure of mutual irrigation companies to shore up their creaky systems. The C-BT promised more water without local districts having to pay much for the works that would deliver it, since the region was only required to re-pay $25 million of the overall cost of a project that was budgeted to cost $50 million (actual costs later exceeded $150 million). The water from the C-BT was supposed

\textsuperscript{73} Ralph L. Parshall, \textit{Agricultural Economic Summary Relating to the Colorado-Big Thompson Project} (Fort Collins, Colo.: s.n, 1937).
\textsuperscript{74} For one example of his misgivings about trans-basin diversion, see Parshall to M.R. Lewis, 21 September 1930, Irrigation Research Papers, Box 5.
to cost $2 or less per acre-foot, much less than what farmers were currently paying for water late in the season.\textsuperscript{75} Whether Parshall foresaw that the C-BT would run far over budget or not, he understood that it was a good financial deal for Piedmont farmers. So, for a time, Parshall stopped beating the drum of efficiency, and instead preached the water gospel of abundance.

Though Parshall’s support of the C-BT reflected the compromise of some of his efficiency ideals, Great Western Sugar possessed no such reservations in its promotion of the water project. In the mid-1930s, Great Western’s water rights remained insecure. In fact, during the 1934 refining campaign, the company’s ditches ran dry, and it had to beg local irrigation companies such as Home Supply for water to finish its operations.\textsuperscript{76} More importantly, the company was conscious of the relationship between water availability, water security, and the number of sugar beets grown and harvested each year. More available water would encourage farmers to grow beets, and increase beet tonnage in the average harvest. The need for more water was punctuated by recent research. H.E. Brewbaker, a USDA sugar beet scientist and regular columnist for Great Western, wrote an article in the drought year of 1934 espousing the importance of late-season water for beets. Brewbaker’s columns were summarized in Great Western’s grower magazine, \textit{Through the Leaves}.\textsuperscript{77} It was mailed to all of the company’s growers on a bi-monthly basis. Since the majority of irrigated farmers on the Piedmont also grew beets for Great Western, \textit{Through the Leaves} offered an ideal platform to broadcast its support for the C-BT.

\textsuperscript{75} In 1938, when the C-BT passed Congress, water users on the Piedmont paid $1.50 per acre foot of water on demand. Parshall points out that, from 1925-1934 in the Cache la Poudre Valley, the average cost of water on demand was $4 per acre foot. See Tyler, \textit{The Last Water Hole}, 102; Parshall Report, 32-33.
\textsuperscript{76} Keirnes, Water, 42.
Articles in *Through the Leaves* from 1936-1938 espoused much of the economic reasoning put forth by Parshall, though they were peppered with homespun wisdom and couched in folksy stories. In its first promotional article in 1936, Great Western’s President of Colorado Operations exclaimed that the C-BT was the “biggest opportunity northern Colorado has had since the beginning of irrigation development in this country,” and that the lack of trans-basin water had resulted in an average loss of $400 annually for sugar beet growers. Put another way in a separate article, growers should expect three additional tons per acre with the new water available in their ditches. Moreover, when compared to other on-demand water sources in the region, the new water would be cheaper by at least 50%. Recognizing that many growers had begun pumping underground water during the recent drought, Great Western cited a CAC study claiming that C-BT water would recharge underground aquifers, and thus, the wells that some growers relied on. Following that article, there was a picture of Frank Berglund, a beet grower who was able to make his own irrigation pump out of scrap materials on his property, encasing the well with used oil drums. Following that was an inset describing the work performed by a landlord and his tenant in digging a well. According to the story, his land yielded five more tons of beets per acre than the average in his district. Great Western even enlisted nationwide sources to make its case. In cooperation with other western beet sugar companies, they convinced the National Broadcasting Company (NBC) to do a short radio program. Titled, “Sugar Beets Tell the World,” and transcribed in *Through the Leaves*, the broadcast emphasized how sugar beets grown in the irrigated regions of the West contributed to the American economy, providing figures on grower income, railroad shipments, resources used in refining beets into sugar, and the varied ways beet sugar was consumed. To hear Great Western tell it, beet sugar was essential to the American economy, and the C-BT was essential to the beet sugar industry.
Support and development of the Colorado-Big Thompson Project seems to run counter to the idea that Piedmont irrigation was characterized by widely dispersed power in water. In the C-BT, it seems, is an example of the marriage of technocracy and power consolidation that Ralph Parshall supported. Instead of water rights being vested in small, dispersed irrigation companies, the federal Bureau of Reclamation was building a massive project that presented the possibility of consolidating control of water into the hands of experts. And yet this was not the hydraulic society described by Donald Worster. Though Reclamation employed expertise and engineering technology to overcome natural obstacles, their efforts did not result in water domination by corporate and state interests. Rather than dictating the terms under which C-BT water would be used, Reclamation gave in to many of the demands of irrigators on the Piedmont, and compromised on principles that had been central to the agency since its founding in 1902. Further, local irrigation companies retained and even added control over their water infrastructure. Finally, even though the structures built to move water across the Continental Divide demonstrated human mastery over nature, the canals, ditches, and reservoirs on the Piedmont looked and operated much the same once the C-BT was built as they did prior to its construction.

The C-BT broke with long-established Reclamation rules and precedents that had ramifications for the Piedmont’s agricultural future. At the heart of Reclamation’s philosophy since 1902 was the belief that the lands of the American West should be settled by small farmers, that Reclamation’s water projects were crucial to making some remaining western lands arable, and that Reclamation’s projects could return construction costs in fees collected for water use. Following precedent set by the original Homestead Act, waters from Reclamation projects would

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78 See Worster, *Rivers of Empire*. 289
only be available to settlers on plots of 160 acres or less. Though these rules were widely violated, they remained at the heart of the Bureau’s philosophy. Piedmont lands did not fit either that statutory or the compromised Reclamation template in the 1930s. There was little acreage available for settlement, and lands that were available were some of the most expensive in the West. Consequently, any Reclamation project on the Piedmont supported existing farmers, not new settlers. Though the average irrigated acreage per farm was less than 100 acres on the Piedmont in 1937, many existing farmers irrigated more than 160 acres.\textsuperscript{79} C-BT proponents successfully argued that the Bureau of Reclamation’s mission to support farms of 160 acres or fewer was irrelevant in this case since irrigated farming had already developed in the region. The need was not to develop new agricultural lands, but to support those already farmed. As a result, the C-BT became the first Bureau of Reclamation project that contained no acreage limitations and was built explicitly to support existing farmers.\textsuperscript{80}

Water on the Piedmont was managed much as it had been before, primarily by the farmers/stockholders and their mutual irrigation companies. To manage the new infrastructure of the C-BT, residents of the region who received these new waters voted to establish a new irrigation district, called the Northern Colorado Water Conservation District. It managed the series of dams, tunnels, and diversions that brought water from across the mountains. But once water tumbled from the heights it flowed into the same canals, ditches, and reservoirs that were built and managed by mutual irrigation companies. In fact, most of the 320,000 acre-feet of water from the C-BT was purchased by those companies at the request of their stockholders.

\textsuperscript{79} The average size of an irrigated farm on the Piedmont was 96.5 acres in 1937. See Parshall Report, 3.
\textsuperscript{80} This provides support for Donald Pisani’s argument that the Bureau of Reclamation had ceased to support any larger agrarian philosophy by the 1930s, and instead functioned as more of a construction agency. See Donald J. Pisani, \textit{Water and American Government: The Reclamation Bureau, National Water Policy, and the West, 1902-1935} (Berkeley: University of California Press, 2002), 272-295.
New bureaucratic agencies did not emerge to instruct farmers how to manage their ditches or fix leaky reservoirs, or, in the case of Great Western Sugar, to clean up polluted waters. When viewed from the perspective of the massive reservoirs built to store water on the west side of the Continental Divide, or from the vantage point of a 13-mile tunnel bored beneath jagged mountains, the C-BT represented a radical departure from previous human efforts to manage nature. But from the perspective of Piedmont farmers, only the quantity and seasonal distribution of water had changed.

While the C-BT did not consolidate power among an elite group of technocrats, officials of the federal government, and industry – what Worster calls the iron triangle that dominated California’s “hydraulic society,” - it did present a clear message about the relationship between water and wealth distribution on the Piedmont. Since mutual irrigation companies purchased most water rights, water was only available to those who already owned land and possessed water rights. In effect, this Reclamation project represented a turnabout in Reclamation philosophy – even if the Bureau’s practice had not reflected its founding principles since at least the 1920s - since it sustained established farmers at the expense of new ones. It sent a message that irrigated farming in the region could no longer tolerate additional entries. Any new water that entered into the system for agricultural purposes would funnel into the hands of those who already held water rights. One of the central features of water rights on the Piedmont prior to the C-BT was that they were widely dispersed. This facilitated a broad distribution of land and wealth. In the years that followed the C-BT’s construction, the rising value of irrigated lands precluded new farmers from entering and made existing ones wealthier. When the Bureau of Reclamation built the C-BT, it did not expand its power on the Piedmont; rather, it reinforced the power of farmers who already lived there.
Though the C-BT did support existing and widely dispersed power structures, it was also a harbinger of change, and the South Platte Watershed would bear some of the workload associated with that change. When engineers finally bored the Alva Adams Tunnel under the peaks of Rocky Mountain National Park in 1947, Piedmont farmers received the bulk of the new supply. The increased water security that resulted furnished some of the confidence needed to plant more water-intensive crops. By that time, plant scientists, led by researchers at the University of Illinois, had developed hybrid varieties of corn that could be grown in large quantities on the Piedmont. These new hybrids required even more irrigation than sugar beets, especially late in the season when C-BT water was available. Ironically, then, the C-BT signaled the end of sugar beets’ reign as the primary cash crop on the Piedmont. Unlike sugar from beets, the new hybrid corn was not destined for human consumption. Rather, much of it ended up in the feed troughs of the new full-time cattle feeding operations. These differed from the winter feeding operations that formerly dominated Piedmont agriculture. Under that system, farmers bought pasture-raised cattle after the fall harvest, fattened them over the winter on a diet heavy in sugar beet pulp and silage, then sold them to market in the spring, utilizing the manure as fertilizer. The new feed lots concentrated solely on cattle, fattening them year round in tightly packed pens on a diet heavy in the new hybrid corn. With no use for the overwhelming quantity of manure, what had formerly been fertilizer now became waste. As with sugar beets before, industry cleansed its wastes with water. Gravity propelled that water downward. And the exhausted streams of the Piedmont went to work again.
“The overloaded mind tries to solve its problems by oversimplifying itself and its place—that is by industrialization. It ceases to work at the necessary likeness between the processes of farming and the processes of nature and begins to order the farm on the assumption that it should and can be like a factory. It gives up diversity for monoculture. It gives up the complex strategies of independence (the use of manure, of crop rotations, of solar and animal power, etc.) for a simple dependence on industrial suppliers (and on credit).”

Wendell Berry

In 1971, the ecologist Barry Commoner penned a sweeping critique of the human relationship with the environment. Commoner argued that, since World War II, Americans had forged unhealthy relationships with the natural world, resulting in resource depletion; pollution of soil, air, and water; and hazards to all living creatures. In Commoner’s assessment, “any productive activity which introduces a substance foreign to the natural environment runs a considerable risk of polluting it.” Looking specifically at agriculture, Commoner argued that farming was no longer concerned with maintaining soil health and crop diversity. Rather it had come to rely on a host of synthetic chemicals – products of state-sponsored science, industry chemists, and college agricultural experiment stations – capable of expanding farm yields while displacing organisms that maintained ecological balance. As evidence, Commoner pointed to several dramatic trends. Between 1945 and 1970, the manufacture of synthetic nitrogen to

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replenish nutrients taken from the soil by intensive farming practices increased more than
tenfold, pesticide production quadrupled, and the use of mercury – a toxic element employed to
manufacture chlorinated pesticides – increased 3,900%. On the other hand, the use of animal
horsepower - once central to labor and production in American agriculture - declined by 87%
during the same period. In Commoner’s estimation, the new agriculture abandoned the
biological processes formerly found on a typical farm, and replaced them with the synthetic
energies emerging from labs and factories.²

The synthetic chemicals that overflowed from factories and onto the Colorado Piedmont
after World War II fill in the final piece to the region’s industrial agriculture puzzle. Prior to the
war, the Piedmont already possessed many of the markers of industrial agriculture, as we have
seen: corporate control of much of the region’s production, a marginalized labor force, federal
monetary and research subsidies, and the harnessing of the region’s natural resources – water,
soil, and minerals - for factory-style production. Still, prior to the war, most of the energy to
maintain agricultural productivity was provided on the farm or within a few miles’ radius. The
cultivation demands of the region’s primary cash crop – sugar beets – required hand labor, and
the soil’s nutrients, especially nitrogen, were still mostly supplied by cattle manure and nitrogen-
fixing crops such as alfalfa and clover. Alfalfa and beet pulp remained the staple feeds for cattle.
It was an agricultural system focused on productive efficiency within locally available limits.
While Piedmont lands were largely given over to industrial production for distant markets, little
had changed in how they were managed.

Harbingers of post-WWII transformations were evident in the two decades prior to the
war, even if they were not obvious on the Piedmont. An expanding urban population, modern

farm production systems, the surge of agro-industry, and the growing number of scientific experts in agriculture pushed farmers to embrace a logic of higher production and greater efficiency through technology.³ Agri-state researchers and officials promoted standardization of production both on and off the farm, conducted widespread farm demonstrations, and systematized the collection of agricultural data in order to effectively promote their agendas in the farm sector of the nation’s economy.⁴ Expanded output on the farm often necessitated the purchase of more mechanical inputs, requiring farmers to interact with banks, college-trained experts, implement dealers, and federal assistance programs – the same complex of business and government officials who pushed for quantitative efficiency in agriculture. Farmers on the Piedmont were not at the vanguard of mechanized agriculture since the crops which most easily lent themselves to technological standardization – wheat, soybeans, and corn – were not widely grown in the region. However, all of the other indicators that Piedmont farmers were prioritizing the use of technology to facilitate greater efficiency and production were there. Purchases of farm machinery rose rapidly in the 1920s and 1930s, smaller farms consolidated into larger ones, and state-sponsored agricultural research embedded itself deeply in the region.⁵

The research and support infrastructure that would scaffold the explosion of chemicals was also fully developed prior to World War II. The set of relationships between agro-industry and agri-state often referred to as the agro-industrial complex had been developed over the first

³ Agro-industry refers to the complex of actors within corporations who grew, manufactured, promoted, demonstrated, and sold products used within agriculture. It included farm corporations such as Great Western Sugar, as well as makers of farm products such as chemical companies and equipment manufacturers.

⁴ Agri-state encompasses federal and state officials officially tied to agriculture. It included, but was not limited to employees of the USDA, those working at land grant colleges, experiment stations, and as extension agents.

four decades of the twentieth century. Researchers at CAC and various branches of the USDA conducted field tests for, and in collaboration with, corporate agriculture, chemical companies and makers of farm implements. They also formed professional organizations around their shared interests in farm technology. By 1940, they shared a confidence that insects represented one of the largest threats to modern agriculture. Led philosophically by hundreds of entomologists scattered in nineteen divisions within the USDA’s Bureau of Entomology, and buttressed by researchers and extension agents at land grant colleges, agri-state scientists argued that insects on farms and in fields were antithetical to successful agriculture. Consequently, they eschewed biological and cultural methods of insect management and control, which were employed extensively in the late nineteenth and early twentieth centuries, in favor of chemicals aimed at eradication.

As for the chemical industry, it underwent a scientific revolution of sorts during the interwar period. Whereas, prior to World War I, industry formulated biocides with inorganic, heavy metals such as arsenic and lead, the organic compounds they concocted after it were more potent and versatile, and chemical companies had just begun marketing a few for their insect-killing properties in the 1930s. Agro-industry also harnessed the revolutionary Haber-Bosch Process to manufacture ammonia (NH₃), a compound capable of providing easily assimilable

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6 See Chapter four for an example of how those relationships formed in the beet sugar industry on the Piedmont.


8 I have adopted the term ‘biocide’ as a frequent stand-in for ‘pesticide’ since it more powerfully conveys the idea that the purpose of chemicals in agriculture was to kill life. Though I regularly employ the more commonly used ‘pesticide’ for narrative diversity, the term too easily normalizes insects as antithetical to agriculture when in fact the web of insect life present in farmers’ fields is necessary - though also potentially destructive – to successful farming. On the transition from inorganic to organic chemicals between the wars see McWilliams, American Pests, 111–167.
nitrogen to plants. According to Barry Commoner, the pre-war scientific revolution produced “sciences capable of manipulating nature - of creating for the first time on earth, wholly new forms of matter. But until WWII, the practical consequences were slight compared to the size and richness of the accumulated stored knowledge.” By 1940, the technology, research infrastructure, state support, and shared mode of thinking within institutional agricultural circles were all present, even if most of the compounds themselves were not yet commercially available.

The chemical industry was poised to change this. Wartime demands, the lure of profits, and government subsidies enabled the chemical industry to accelerate its research and find uses for many of its new compounds. Many of them were in agriculture. During and after the war, the chemical industry began manufacturing a host of pesticides and fertilizers. As these compounds were cheap and abundant, farmers such as those on the Piedmont embraced the chemical promise of vastly expanded production and reduced labor at minimal costs. Insecticides such as dichlorodiphenyltrichloroethane (DDT), used during the war to kill typhus germs and eradicate jungle mosquitoes, were employed following the conflict to kill insects that fed on crops and livestock. Herbicides, such as 2,4-dichlorophenoxyacetic acid (2,4-D) selectively killed noxious weeds, while leaving most food crops untouched and free from weedy competitors. Soil fumigants and fungicides killed off subsurface pests prior to planting. Meanwhile, new processes to synthesize nitrogen from the air made it possible to supply this critical nutrient to the soil. As a result, crop farmers could focus entirely on growing crops for

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the market with little need to replenish the soil through manure from their own livestock, or plant nitrogen-fixing legumes such as alfalfa.\textsuperscript{11}

The explosion of synthetic products available to farmers relegated agri-state researchers increasingly to the role of support staff for the agricultural chemicals industry. As the number of agricultural compounds poured out of chemistry labs, they had to be tested for their usefulness on a host of crops, and within localized soils and climates. Though some of this experimentation was accomplished on corporate farms, the majority was completed at USDA and agricultural college experiment stations. Since agri-state scientists had largely embraced the promise of efficiency and productivity through technology, they offered few arguments against such an arrangement. As a result, experiment stations employed larger proportions of their time testing chemical compounds for agro-industry. Further, with so many new and promising products on the market, extension agents occupied more of their days instructing farmers on selection and application of synthetics. In the process, the USDA and land grant colleges devoted scant time addressing independent research questions relevant to agriculture, while devoting excessive time to conducting field trials for industry.\textsuperscript{12} While it is debatable whether the knowledge gained benefitted Piedmont farmers financially, there is no doubt that agro-industry reaped rewards from subsidized research. Knowledge acquired from agri-state science enabled industry to effectively market its products and develop new compounds. At the same time, by defining successful farming within the narrow confines of market demands for cheap and abundant


\textsuperscript{12} On the post-war research prerogatives of agri-state scientists see Dunlap, \textit{DDT}, 59–75; Benjamin Ross and Steven Amter, The Polluters the Making of Our Chemically Altered Environment (New York: Oxford University Press, 2010), 118–125; McWilliams, \textit{American Pests}, 194–220.
produce, agri-state scientists narrowed their research prerogatives largely to those promoted by agro-industry.\textsuperscript{13}

The chemical industry also offered monetary and institutional support for agricultural colleges that shaped their research. The nature of those arrangements varied from one institution to the next and from one project to another. In some cases, such as in the hybrid corn experiments conducted at the CAC experiment station from the 1930s through the 1960s, the college offered to conduct experiments for seed and chemical companies to ascertain corn yields when various combinations of seeds and chemicals were employed. In that case, agro-industry provided the seeds and chemicals, while CAC provided the labor, land, and research. In other arrangements, all or part of the research itself was funded by industry. This enabled colleges not only to conduct field trials, but also to hire new faculty and researchers, upgrade and expand facilities, and circulate their findings to broader audiences. In still other cases, agro-industry offered individual scientists at agricultural colleges and the USDA direct monetary support that increased their salaries, allowed them to upgrade their research facilities, and even conduct some of their own research with industry money. Regardless of the particulars of each arrangement, conducting research for agro-industry was lucrative for agri-state researchers and officials. Undoubtedly, it benefitted the chemical industry more. Not only did agri-state researchers conduct field trials under local conditions, but they essentially subsidized industry by providing agricultural lands that chemical companies would otherwise have to buy or rent. When the USDA and agricultural colleges conducted field trials for industry, they provided companies

with knowledge of how their products performed under local conditions. This arrangement presented little financial risk for the complex of agri-state researchers and officials since, generally speaking, they already owned the land on which most of the field trials were being conducted. Performing field trials for industry offered opportunities for financial gain, prestige, and institutional growth. However, while there is no doubt that the USDA and agricultural colleges enriched themselves with industry money, chemical companies gained more from this arrangement.

One of the most significant consequences of agri-state’s embrace of chemicals was the creation of a knowledge economy that foreclosed opportunities to question the consequences of chemicals in agriculture. As agri-state researchers adopted the chemical industry’s prerogatives and embraced its financial support, they were less likely to conduct research that would have uncovered chemical harm. In performing field trials for industry, agri-state scientists adopted a science based on industry’s abbreviated timeline for bringing a product to market. Consequently, they conducted few studies on the long-term impacts of chemicals – on humans, water, wildlife, or the soil. In addition, scientists were reluctant to conduct studies on biological or cultural control of weeds and insects because such studies might point to alternatives to the chemical control of insects. Further, heavy emphasis on field trials pre-empted basic research questions that might have limited chemical use. For example, when seeking to control subsurface insects that preyed on the roots of corn and sugar beets, CAC researchers performed few or no experiments on biological or cultural control of crop pests; however, agri-state researchers conducted numerous field trials to determine which industry compounds proved most lethal to those same insects. Further, as studies emerged in the 1950s and 1960s that

demonstrated harms from agricultural chemicals, or argued that they were ineffective, or called for greater regulation, agri-state scientists and officials often mounted the most strident defense of their ongoing use. Put simply, the animus for agri-state research and the source of its support was the chemical industry. That is not to say that there were no chemical critics within the complex of agri-state scientists and officials, but the dominant narrative, and the lack of experiments that evaluated harms from agricultural chemicals offered little space for dialogue. Moreover, as many insider critics later stated during the late 1960s and early 1970s, they feared that openly criticizing chemical research could endanger their job security. The failure of agri-state officials to question chemical harms was especially damaging when we consider that the complex of scientists within the USDA and land grant colleges comprised the only significant cohort of state-sponsored agricultural researchers in the nation. Their failure to critically examine chemicals in agriculture and the knowledge economy that accompanied agri-state’s chemical embrace left a gaping research hole that might have otherwise opened doors for public dialogue.¹⁵

Constricted research agendas contributed to simplified landscapes, ecological disjunctures, and chemical addiction. As Piedmont farmers reduced crop variety – including monocropping hybrid corn – they employed synthetics to eliminate unwanted pests while adding factory fertilizers to replace nutrients that industrial farming had depleted from the soil. Cultivating fewer crops with the aid of biocides created environments friendly to insects that targeted those crops. Those practices also reduced populations of organisms that preyed on unwanted insects or assisted with nitrogen fixation. To meet the narrow, short-term demands of the market, farmers eroded the interdependencies necessary for a healthy landscape. In addition,

many of the organisms farmers targeted for death developed resistance to specific chemicals. Consequently, in order to continue the march toward higher yields, farmers applied greater quantities and varieties of biocides and fertilizers to achieve the same results. Though some synthetics broke down in the soil more rapidly than others, the net effect of so many chemicals was an accumulation of toxins in soils, air, water, animals, and human food. For farmers, agri-state scientists, and the land itself, the result was chemical addiction. The collective efforts of farmers and agri-state scientists had created an agricultural landscape lacking sufficient quantities of organisms and nutrients necessary for productive farming and opened doors for organisms that preyed on their crops. As the land developed chemical dependencies, farmers had little choice but to manage their farms with synthetic additives to maintain productivity. Further, since agri-state had tied its philosophy and research to industry prerogatives, it would require some fundamental reorientation to de-toxify its scientific agenda.16

Since the late nineteenth century, crop production and cattle fattening had relied on one another. The collapse of open range cattle ranching in the 1880s forced the ranchers who remained on the Piedmont to scale down their operations and pay more attention to the needs of the animals on which their livelihoods depended. In the late 1880s and through the 1890s, cattle ranchers fenced in pasture lands and began raising crops to feed their animals during the winter. Crops and confined cattle meant that ranchers needed water rights and irrigation systems to slake the thirst of their plants and animals. In short, surviving cattle ranchers began to appear in form and function much more like farmers. Crop farmers, for their part, struggled to maintain the fertility of their soils as initial years of productivity had drained the soils of their nutritive value

through over-farming, or poor application of irrigation. Maintaining healthy soils required more soil management than they had originally anticipated. Much of the answer was available behind the fences of the Piedmont’s surviving ranchers in the form of cattle manure. The answer was also supplied by the explosive regional growth of alfalfa, a crop that fixed needed nitrogen into the soil and offered a nutritious feed to cattle. When Great Western built its sugar beet empire on the Piedmont in the early twentieth century, it simply added another feed - beet pulp – into the cattle feed mix. In addition, the exacting soil requirements of sugar beets placed even more emphasis on the need for cattle manure. Cattle and crops developed dependent relationships. By the early twentieth century, the farmer and the rancher were often the same person.¹⁷

Farmers employed chemicals on the Piedmont long before their usage became commonplace. But they were used primarily in reaction to insect infestations rather than as a set of tools to re-order their farming. On the Piedmont, the most common chemical was called Paris Green, an arsenic-based insecticide. In seasons when grasshoppers and web worms infested farmers’ fields, CAC extension agents and Great Western Sugar told farmers to keep plenty of Paris Green on hand. Extension agents carried spraying equipment with them when visiting farms, and instructed farmers on how to mix common poisons. Great Western informed its growers of the availability of its own sprayers and the amount of Paris Green it had on hand.¹⁸

¹⁷ Chapters one and two largely address how farmers embraced cattle and crops on single farms, and the development of the sugar beet industry. On the relationship between sugar beets and cattle, see E. J. Maynard, Beets & Meat: A Practical Manual for Fattening Cattle and Sheep on Irrigated Farms of the Intermountain Area Where Sugar Beet by-Products Provide One of the Principal Sources of Low-Cost Fattening Feed (Denver: Through the Leaves Press, 1945).

Farmers, however, did not plan their soil management, planting, cultivation, and harvesting around agricultural chemicals. These were used as responses to insect infestations during the course of the season. Further, farmers tended to believe that the most valuable tools of their trade consisted of long-held practices such as planned crop rotation, careful soil management, meticulous attention to cultivation, and maintenance and cleaning of their tools to prevent the introduction of bacteria and fungi into their fields. This is not to suggest that farmers as a whole abhorred the use of products that did not occur in nature, or that we can trace modern organic farming through pre-war Piedmont practices. Their willingness to use and occasionally overuse available insecticides such as Paris Green certainly suggests otherwise. Rather, farmers adopted the best, most efficient methods at their disposal.\textsuperscript{19}

In the late 1920s and through the 1930s, Piedmont farming began to reflect a subtle shift toward regular management of farms with the products of agro-industry. It was subtle – perhaps imperceptible – at first. A few ranchers figured out how to raise cattle year round, and so de-emphasized growing crops. They purchased pasture-raised cattle – largely from the Midwest – and fattened them in tightly packed feed-pens. Instead of growing feeds on-site, or purchasing them from local farmers or Great Western Sugar, they imported cheap feeds – especially corn – from the Midwest. With little or no outlet within their feeding operations for cattle manure, what was once fertilizer slowly became waste. Some crop farmers began to experiment with new commercial fertilizers, insecticides, and herbicides that claimed to increase yields and decrease labor requirements. Again, this shift was subtle. It did not involve a wholesale rejection of cattle manure, alfalfa, and crop rotation; rather, it demonstrated an openness to using synthetic

\textsuperscript{19} Areas of the West where pesticides were integrated into crop management include the fruits orchards of California’s Central Valley and the Yakima Valley of Washington. See Stoll, \textit{The Fruits of Natural Advantage}, 94-123 and Davis, \textit{Banned}, 1-37.
products manufactured in factories and laboratories to bolster productivity instead of a dogged reliance on locally available fertilizers and feedstuffs. Corn also crept onto the Piedmont landscape in the late 1930s. Newer hybrid varieties, bred in Midwestern agricultural colleges, could grow to maturity during the Piedmont’s abbreviated season. Corn was no stranger to the Piedmont, but it had always been a marginal crop, and it was not ideal for a crop rotation that included sugar beets. Further, since previous corn varieties produced relatively low yields, it was not the ideal crop for irrigated agriculture, where water costs and high land values demanded more lucrative crops. The new hybrids required copious irrigation, produced heavy yields and, with a host of machinery and chemicals, could be grown on the same plot of land from one year to the next.  

Prior to World War II, there were no wholesale changes in managing the Piedmont agricultural landscape, but the perceptive observer could foresee such changes on the horizon.

Fears over declining soil fertility in the late 1920s pushed Piedmont farmers to fertilize their farms with imported materials. Phosphorous is one of three major nutrients essential for plant growth (the others being nitrogen and potassium). It is indispensable to the structural tissues of plants, as well as the bones and teeth of animals. Absorbed into plants as phosphates, phosphorous is available in abundance in the Rocky Mountains to the west of the Piedmont; however, unlike nitrogen, phosphorous cannot be recycled into the soil through effective crop rotation and the use of manure. As wind and water eroded rocks over millennia, phosphates were deposited in abundance on the Piedmont, providing an essential plant nutrient. This became apparent in the early 1900s when Great Western, CAC, the USDA, and several fertilizer manufacturers performed experiments with phosphate fertilizers. While other beet-producing regions such as Michigan saw benefits from these new additives, phosphate fertilizer had

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20 On the development of hybrid corn by seed companies and agricultural colleges, see Fitzgerald, *The Business of Breeding*. 

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virtually no impact on Piedmont crop yields. Farmers viewed it as a needless expense. But, in the mid-1920s, Great Western and CAC began to notice declines in phosphorous available in the soil. Consequently, they began performing experiments. Using cheap phosphorous fertilizer obtained from mines on Pacific islands and processed in the United States, Great Western and CAC introduced the fertilizer onto beet lands that were already models for productivity. Sugar beet yields quickly increased. Great Western wasted no time spreading the phosphorous gospel to its growers, performing farm demonstrations, and peppering growers with articles on its benefits in its grower magazine, *Through the Leaves*. By the early 1930s, adding imported phosphorous had become standard practice.\(^{21}\)

Large chemical manufacturers and their products slowly crept onto the Piedmont in the mid-1920s. Companies such as DuPont and Dow possessed heavy surpluses of wartime organic compounds such as ammonia, formaldehyde, chlorine, and mercury, used during World War I for manufacturing explosives and concocting poisonous gases.\(^{22}\) They found agriculture to be a field ripe to employ these compounds. Seed treatments and disinfecting provided one promising avenue for experiment. This involved applying a chemical spray or dust to seeds prior to planting. Seed disinfection operated on the opposite principle as fertilizer. Adding phosphorous and nitrogen bolstered soil biology and boosted plant growth. Seed treatments, on the other hand, functioned as fungicides and insecticides whose goals were to kill microscopic fungi and insects attached to the seed, thus inoculating them against disease. Mercury and formaldehyde,

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both used in the manufacture of explosives to take human life, were found effective in killing fungi and insects as well. To add a further layer of protection, companies introduced chloropicrin, a derivative of chlorine used as tear gas in World War I, to temporarily sterilize the soil in advance of planting. Chloropicrin was one of the earliest of a class of soil sterilizers called fumigants, whose goal was to kill insects, fungus, and bacteria that fed on the roots of growing plants. The stage was set for the introduction of subsurface chemicals on the Piedmont.

To understand how those chemicals became an essential part of Piedmont agriculture, we will examine the introduction of DuPont Chemicals’ first commercial seed disinfectant, hydroxymercurichlorophenol, or Semesan. As its chemical name suggests, Semesan included both chlorine and mercury as active ingredients. After some initial testing, DuPont convinced USDA’s Division of Sugar Plant Investigations (SPI), as well as experiment stations in Colorado, Michigan, and Utah to perform seed disinfection experiments with Semesan. Beet sugar refiners in Colorado also cooperated. Seeds from crops such as sugar beets, corn, and alfalfa were all treated with Semesan, as well as with the products of several other chemical manufacturers. The results were encouraging for DuPont, with yields of Semesan-treated seeds generally increasing. Consequently, DuPont chose to manufacture the product commercially. In magazine ads and on product labels, DuPont then claimed that Semesan resulted in quicker and more efficient plant germination, sturdy crops that matured earlier in the season, and bountiful harvests. The company also appealed to public-minded expertise when it quoted USDA and experiment-station researchers. In one of its 1927 catalogs, DuPont claimed that Semesan had been “tested by agricultural colleges and experiment stations,” and was “recommended by Government experts, agricultural colleges, county agents and large growers in every section of the country.” DuPont went on to quote farmers and extension agents who had allegedly
participated in these experiments. One sugar beet farmer claimed, “the Semesan-treated beets were much stronger and healthier right up to harvest.” Another extension agent exhorted, “tests of Semesan on beets, sweet corn, peas, and tomatoes...have shown that the tendency to damping off is almost entirely eliminated.” DuPont also received free publicity in the form of USDA and experiment station publications, since researchers were obligated to publish their results. By the late 1930s, the seed treatment products of chemical companies such as DuPont had found a permanent place in Piedmont agriculture.

A new pattern of relationships also unfolded in the process. As chemical companies such as DuPont sought opportunities to use their organic compounds within agriculture, it was not enough to advertise the effectiveness of a new product. They needed to convince farmers of their chemical need. The USDA experiment stations and state agricultural colleges were tailor-made for such a purpose. By the 1920s, state-sponsored scientists generally embraced innovations that could expand agricultural productivity and efficiency. In regions such as the Piedmont, they were already conducting cooperative field experiments with agricultural corporations such as Great Western Sugar. Consequently, when the chemical industry promised to boost yields through a bevy of new products, they were more than willing to offer space on farms and experiment stations to test out the new concoctions. Chemical companies did not

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23 Damping off is a horticultural disease or condition, caused by a number of different pathogens that kill or weaken seeds or seedlings before or after they germinate. It is most prevalent in wet and cool conditions.

24 The Hagley library contains numerous advertisements and publications for DuPont’s various chemical products. Most are individually catalogued and shelved. I consulted multiple publications for each product referred to here. For the sake of footnote brevity, I will not cite them all. On Semesan, see “DuPont Semesan: The Premier Seed Disinfectant for All Agricultural Purposes,” 1926, and “Dupont Information Bulletin, 25 August 1927,” (DuPont de Nemours and Company: Wilmington, Del.), Hagley Library, Wilmington, Del (Hereafter Hagley Library); “Treated Seed Experiment, M.L. Reeder Farm – Brigham City, Utah,” 23 April 1925, Sugar Beet Collections Reports, Special Collections, National Agricultural Library, College Park, Maryland (Hereafter NAL Special Collections).

simply add to agricultural research; they altered it entirely. Possessing budgets, research scientists, and a host of chemicals far beyond anything that state-sponsored science could concoct, chemical companies produced a stream of new products previously unimagined. With so much to test, agricultural colleges and small federal outfits such as SPI became laboratories for industry test products instead of performing basic research. Often, state-sponsored researchers discovered additional uses for industry products. Consequently, while farm productivity increased, chemical companies benefitted from federally funded research, and gained feedback used to selectively market their products. The relationship between industry and the state was growing, and industry was calling the tune.

This new relationship had consequences for the direction of agricultural science, since the new compounds were developed to serve industrial profit over farmer’s livelihoods. SPI research on the Piedmont offers a telling example. Experiments performed on sugar beet lands in the 1910s and 1920s by state-sponsored and Great Western scientists were primarily conducted by researchers who lived and worked there, or by SPI researchers on assignment in the region. They took soil samples, tried various irrigation regimens, and worked out effective crop rotations. Further, it was well-known on the Piedmont that Great Western and CAC prioritized the hiring of agriculturalists who received their degrees from that college.  

In other words, knowledge of local agricultural practices was critical to their work. As the growing arsenal of chemical products found its way into the region, agricultural employment patterns remained the same. What changed was the source and character of agricultural research. New synthetic compounds were developed by chemists in distant labs. Since industry chemists

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26 For an example of one of those experiments and the researchers who participated in it, see Townsend Office Files, Records of the United States Department of Agriculture, Record Group 54, National Archives Building II, College Park, Maryland Records of the Division of Sugar Plant Investigations (hereafter SPI), Box 1, folder A.
typically developed compounds before a particular use was found for them, they were generally unconcerned with whether a compound was useful in formulating a stronger plastic or resisting the pests that targeted field corn. What mattered was that the product was useful and profitable. Functionally then, experiment station scientists became more occupied with testing industry products designed to make agriculture more productive and efficient, but not calibrated for a particular landscape or the needs of local farmers. In the 1920s and 1930s, industry chemicals had not yet come to dominate farming methods on the Piedmont, but there was clearly an upward trajectory. As state-sponsored research scientists employed the new tools of industry, they embraced the indispensability of farm chemicals.27

It was not difficult to convince most Piedmont farmers to deploy the new chemical tools. As farm incomes dropped in the 1920s relative to the cost of living, farmers sought technologies that would deliver high financial returns with minimal investment. While farmers could purchase tractors and other farm implements to accomplish more work, those required significant monetary investments. Seed treatments and soil fumigants were relatively cheap by comparison. For example, DuPont claimed that one pound of Semesan could treat 240 pounds of the average seed if they were dusted with the product, or 960 pounds of seed if liquid applications were employed. At a cost of $4 per pound, this seemed to be a wise investment. For companies such as Great Western, which supplied its growers with seed, this seemed even more lucrative, as they could buy the product in bulk, at $240 per 100 pounds, and inoculate the seeds of an entire beet growing region. In fact, one pathologist at Kansas State suggested that the use of seed treatments yielded more than $20 in profit for every dollar spent. The Agricultural Adjustment Act and subsequent 1930s legislation encouraged the new chemicals even more. Since the federal

government paid farmers growing crops such as corn and sugar beets for acres taken out of production, it became critical that the reduced acreage produce high yields. Chemicals promised higher yields with little investment.\textsuperscript{28}

Previously established relationships between farmers, Great Western Sugar, and extension agents also encouraged the transition. The majority of Piedmont farmers in the 1920s grew sugar beets for Great Western. For two decades, the company had been conducting research at its own corporate farms and disseminating it through its field agents. Agricultural researchers at Colorado Agricultural College (CAC) had cooperated with Great Western in some of these experiments as well as conducting some of their own. These were disseminated through demonstrations, publications, and the work of county extension agents. By the 1920s, sugar beet growers acknowledged that, though effective cultivation was their domain, the science behind expanded yields, pest management, and increased sugar content in each beet was largely beyond their expertise. Consequently, when Great Western and agri-state researchers demonstrated that phosphates and fumigants could expand yields and kill pests, growers were likely to confine their concerns to the financial realm. Would these new tools generate greater profit? They did.

The biological sciences offered another method of manipulating seeds to produce higher yields. Their work was especially evident in corn. Prior to 1940, corn was a marginal crop on the Piedmont for several reasons. First, the region’s climate made the crop unpredictable. During some years, the season was long enough to bring a solid crop to harvest, while in others, late spring or early fall frost could kill off the entire crop. In addition, cool summer nights – colder than in the Midwestern Corn Belt – slowed corn’s growth and retarded its yields. Many dry land farmers in eastern Colorado were willing to risk planting corn where yields averaged

\textsuperscript{28} “DuPont Semesan: The Premier Seed Disinfectant”; “Authorized DuPont Seed Treating Service, Ceresan and Arasan, Wherever Farmers See This Sign,” Hagley Library.
less than half of those achieved by Midwestern farmers. Colorado’s dry land farmers were willing to accept such poor yields primarily because their land costs were minimal compared to their Piedmont neighbors. Further, they had not invested in irrigation (though a small number supplied well-water to their crops), so their choice of crops was limited by what seasonal precipitation and moisture stored in the soil could provide. For Piedmont farmers – most of whom had stock to feed – corn was too risky. Since corn’s primary use was as grain and silage for stock, a poor year could impact both crops and animals. So, farmers in the region accepted the logic that sugar beets were the most lucrative crop to grow, and that its byproducts were the most cost-conscious and efficient feed-source for their stock.\textsuperscript{29} As late as 1936, 90% of all Colorado acres planted in corn were on non-irrigated lands.

Corn hybrids transformed the logic of crop production on the Piedmont. Traditionally, improving corn required time and careful breeding over the course of several years. Farmers selected corn seed for desired traits such as disease resistance, high yields, and early germination, and through careful selection from one year to the next, they were able to produce new varieties adapted to their needs. The process of breeding in a single desired trait could take more than a decade and involved much trial and error. But, the skills of selective breeding were accessible to a dedicated farmer, and he or she could achieve the same impressive results as an experiment station researcher could. Hybrid corn seeds – and all hybrid seeds – were fundamentally different in their method of breeding and in their accessibility to most farmers. Using principles of Mendelian genetics, seed companies and researchers at experiment stations developed methods for breeding in desired characteristics within one generation. The clear

advantage of the new technology was that improved breeds emerged rapidly. This included hybrids bred to germinate and develop rapidly in the Piedmont’s cooler soils, resist insects and disease, and yield more bushels. The first commercial hybrid corn seeds were developed by Henry A. Wallace in Iowa in 1923, but hybrid seeds did not achieve commercial success until the mid-1930s when several large seed companies marketed hybrids. By the end of World War II, hybrids dominated the nation’s corn fields. In addition, they altered farmers’ relationships with their crops. Hybrid seeds did not reproduce their genetic characteristics from one generation to the next, so it was useless for farmers to save seeds. Moreover, breeding hybrids required the skills of trained plant biologists operating in a controlled lab environment. Farmers who wanted to tap the advantages of hybrid corn would have to purchase their seeds annually, essentially transforming seed producers into seed consumers. Moreover, seed companies patented each year’s crop of hybrids, effectively criminalizing the act of saving hybrid seeds.\(^{30}\)

Recognizing the value of the new seeds, CAC quickly jumped on the hybrid bandwagon. Between 1937 and 1939, the school’s experiment station tested 65 new hybrid corn varieties. Testing them against traditional open-pollinated corn varieties, they found that the new hybrids out-yielded their predecessors by 7.4-9%. Tests on newer varieties between 1942 and 1945 yielded 10-20 more bushels per acre than the best open-pollinated breeds, and produced 20% more silage – primarily used to feed stock. CAC’s testing of hybrid corn displayed a continuance of patterns first exhibited in its field testing of seed treatments. Researchers at seed companies developed new seed strains annually. Experiment station scientists agreed to test them and provide feedback to the company on germination, yield, and disease resistance. With limited fields on which to test the hybrids, CAC allowed each seed producer to contribute three

seed varieties per experiment station, two of which had to be ready for commercial production so that Colorado farmers could not only learn the testing results, but immediately purchase the most desirable seeds. Consequently, experiment station researchers functioned as product testers while offering a seedbed of competition for the new hybrids about to hit the market. Those experiments would continue through the 1960s. As with seed treatments, hybrid testing offered another example of how the agro-industrial complex reflected industry prerogatives.31

While Piedmont farmers did not immediately embrace the new hybrids, several factors supported the adoption of hybrid corn. The fact that corn could be adapted successfully to the Piedmont’s irrigated agriculture certainly opened eyes, but the small increases in yields present by 1940 enticed very few to change their crop rotations. However, by the mid-1950s, per-acre yields on irrigated lands had more than doubled over 1940 totals, luring farmers to plant corn. The market for corn also expanded. Beginning in 1930, a small but growing number of cattle ranchers abandoned mixed farming in exchange for fattening cattle year-round in confinement. While beet pulp still provided much of the local feed, an oversupply of corn in the Midwest during the early 1930s caused prices to fall, making it economical to purchase grain and silage from the Midwestern Corn Belt. Cattle feeders could eliminate transportation costs if that same corn was grown on the Piedmont. The new hybrids slowly made that economically feasible for farmers on irrigated lands. Further, agricultural chemists from both industry and the state invested large sums of research money to develop a host of corn-based products, including sugar,

fuel, oils, solvents, and plastics. Corn was not just a product of industrial agriculture, but an industrial input.\textsuperscript{32}

Hybrid corn is one example of the unforeseen environmental consequences on the horizon for Piedmont agriculture. According to soil science professor Hans Jenny, modern hybrid corn cropping results in more soil abuse than any other major crop. It uses up significant stores of organic nitrogen, the most essential element for plant growth.\textsuperscript{33} When supplemented by manure and nitrogen-fixing crops, hybrid corn could be grown on limited acres on the Piedmont; however, as hybrid acreage increased, and many farmers abandoned their manure-producing stock, the chemical industry developed processes for manufacturing synthetic nitrogen to replace what had been depleted by demanding crops. Hybrid corn also gulped more water than open-pollinated breeds, a fact that was already being addressed on the Piedmont in the 1940s and 1950s as Piedmont farmers awaited the addition of 320,000 acre feet of water from the Colorado-Big Thompson (C-BT) Trans-Basin Diversion Project. In addition, corn presented a unique problem that begged for a chemical solution. As a species, corn typically does not attract hordes of insects; however, its growth is particularly sapped by weeds. Of course, when farmers poured more water onto the new hybrids, weeds germinated with greater frequency and grew with vigor. The expense and inefficiency of weed eradication through machine cultivation and hand labor rendered those solutions untenable. Selective herbicides that could destroy weeds without limiting yields were the solution. Conceived in chemists’ labs in the early 1940s, they were widely available by 1950. In 1940, Piedmont nitrogen was still supplied on the farm, C-BT

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\textsuperscript{32} The first commercial cattle feedlot operator on the Piedmont was Warren Monfort. For a brief summary of his early operations see \textit{International Directory of Company Histories, Volume 13} (New York: St. James Press, 1996), 350-352.

water was as yet unavailable, and chemicals were of relatively minor importance. That was about to change.

To understand why biocides became commonplace on the Piedmont in the post-war period, it is important to see how chemical companies talked about and promoted the new products. Chemical companies not only developed ad campaigns to support their line of biocides but distinct manners of speaking about them that varied depending on whether they were talking to the agricultural community, or the public at large. To farmers, they promoted their products as destroyers of apocalyptic insect hordes, generators of wealth and ease, and even examples of ecological progress. To the non-farming consumer, agricultural chemicals were at the heart of healthy eating and an indispensable piece of the abundant American life. But concocters of agricultural chemicals required the validation of the vast complex of agri-state scientists, especially those at agricultural colleges. On the Piedmont, companies such as Dow and Union Carbide were aided by experiment stations and extension agents of CAC, who field-tested each of the new chemical compounds on the market, then recommended them to their farm constituents. Chemical companies also performed cooperative experiments with agricultural corporations such as Great Western Sugar. In addition, agro-industry researchers were aided by USDA and agricultural college entomologists whose profession had embraced chemical solutions to pest problems since the 1910s. Moreover the labors of all of these actors – researchers at chemical companies, experiment station scientists, USDA officials, and entomologists – mutually reinforced each other.

In the wake of World War II, chemical companies, entomologists, and agricultural researchers at the USDA and college experiment stations employed the language of physical and economic warfare to promote the effectiveness of new insecticides, such as DDT, and herbicides,
such as 2,4-D. As Dow invested heavily in herbicides after the war, it began publishing a magazine titled, _Down to Earth_, in 1945. Targeted at farmers and retailers of agricultural products, the magazine’s inaugural articles were peppered with titles such as “The War Against Soil Pests” and “2,4-D Declares War on Weeds.” Dow had the same audience in mind when it produced a 15-minute film in 1947 titled, “Death to Weeds.” Opening with dramatic music reminiscent of the Civil War saga, “Gone with the Wind,” the film used the language of a courtroom drama to create a class-action lawsuit pitting the plaintiffs, farmers, against the defendants, weeds. Charging that “weeds are our natural enemy,” the film stated that they inflicted “never-ending warfare against the American farmer.” Having established malicious intent, the film’s narrator cited financial harm, claiming that weeds cost farmers $3 billion annually. Further, the film claimed that the reason these herbivorous criminals remained at large was due to backwards methods of control, going on to offer Dow’s modern line of agricultural chemicals as the agent capable of bringing these vigilantes to justice. The heroes of the film were not Dow’s line-up of biocides, but its agricultural chemists who “always have the answer” to weed pests. According to the film, clear evidence proved that weeds were guilty, and deserving of the death sentence.34

DuPont, one of Dow’s primary competitors in the growing agricultural chemicals industry, took a less militant approach, but adopted an otherwise similar message. It claimed that losses from weed pests were as high as $3 billion annually, taking an average of $450 out of the paycheck of every farmer in America. Seeking to attract farmers raising livestock, DuPont claimed that “animals grazing over 2,4-D sprayed areas have not been affected in any

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34 "The War Against Soil Pests,” _Down to Earth_ (hereafter _D to E_), 1, no. 4, 1946; “2,4-D Declares War on Weeds,” _D to E_ 1, no.3 (1946); _Death to Weeds_. (Midland, Michigan: Dow Corporation, 1947), Chemical Heritage Foundation Library and Archives (Hereafter CHF Library), Philadelphia; On the persistent use of the war analogy by manufacturers of pesticides see Russel, War and Nature.
way…when (2,4-D is) applied as recommended in this folder.” As in Dow’s ads, DuPont enshrined its products within a narrative of progress. In the narrative of one such advertisement, “Chemistry and the Farmer” the farmer moved westward always seeking better soil. At every turn, pre-modern farming methods and “acts of God” conspired to ruin his operations. To solve this, the university-trained expert provided heroic solutions through more scientific methods of farming and a bevy of insecticides, fungicides, herbicides, and seed disinfectants. Now, according to the ad, farmers relied “heavily on chemical products.” Citing the economic benefits of agricultural chemistry, the ad stated that “the control of just one insect pest has saved crops worth $10 million in a single year. Chemistry has resulted in healthier surroundings and help in eliminating strenuous tasks.” Industry’s message to farmers was that chemicals were a modern, rational, economic, and even ecologically sound response to the hordes of insects bent on their ruin. Moreover, agricultural chemists were beacons of help and progress.\textsuperscript{35} That same message of progress epitomized how the chemical agricultural industry packaged itself and its products to the consumer. As Americans benefitted from rising standards of living and consumer abundance during the post-war period, chemical companies hoped that consumers would connect chemistry to their good fortune. For example, in a 1952 issue of the \textit{Saturday Evening Post}, Dow published an ad with the headline, “Food..fit for an American.” It stated, “no people on earth, kings or commoners, ever enjoyed such abundance of tasty, healthful food as you will find on the shelves of your grocery store.” Set on a table, in the foreground were examples of the abundance – fruits and vegetables, meats and cheeses, flour and canned goods – each one appealing in either perfect packaging or blemish-free rawness. Behind the table stood people of all ages, and various professions, including a black professional, and an

\textsuperscript{35} “DuPont 2,4-D Weed Killers for Better Weed Control,” and “Chemistry and the Farmer,” Hagley Library.
elderly clergywoman who appeared to be of Eastern European origin. The ad went on to explain that over eighty Dow products “help the farmer increase his yield of crops,” and then went on to list several farm chemicals. Additionally, the ad claimed that chemical products were responsible for feeding 27 million more Americans than a decade ago. The ad seemed to suggest that even the new, more inclusive America was in part a product of the chemical industry. Other Dow ads from the 1950s argued that, like the perfect produce on grocery store shelves, the chemicals used to grow food were products of nature. Moreover, not only were farmers netting record yields, but they were doing it with less toil, freeing them to engage in other pursuits not defined in the ads. While few Americans purchased farm chemicals, the chemical industry hoped that they would be grateful for their existence.\(^{36}\)

The chemical industry was not monolithic in its product promotion. As agricultural chemicals proliferated after World War II, professionals associated with the industry formed their own organizations. The most prominent among them was called the National Agricultural Chemical Association. Formed just after World War II, it published the *Journal of Agricultural Chemicals* on a monthly basis beginning in 1946. Its articles drew from a broad swath of parties all interested in the expansion of the agricultural chemical industry. These included scientists from the USDA and agricultural colleges, editors of small farm publications, economic entomologists, representatives of agricultural corporations such as Great Western Sugar, large farmers, and researchers from chemical firms. The journal offered a forum for agro-industry to publish initial research on new chemical compounds in their experimental stages, and for experiment station scientists to report the utility of those same compounds after they had been used in local field tests. It also was a clearinghouse for statistics and summaries on the

\(^{36}\) “The Chemistry of Good Food,” Dow Advertisements Collection, no. 33, Box 2 and “Food…Fit for an American,” Dow Advertisements Collection, no. 121, CHF Library, Box 7.
production and usage of every class of agricultural chemical. During the post-war era, those stats almost universally formed an upward trajectory of chemical usage. In addition, the Journal published editorials on the state of the industry, legislation that might impact their industry, and celebratory histories of their field’s accomplishments. In short, the *Journal of Agricultural Chemicals* was an excellent source for taking the pulse of the agricultural chemicals industry and understanding the relationships within it.

One set of relationships that was especially important for understanding the adoption of chemicals on the Piedmont was that between industry scientists and those of the USDA and experiment stations. By the late 1940s, few agri-state scientists were doing any original research meant to benefit local farmers. Rather, much of their time was spent conducting field tests on a host of chemical compounds concocted by industry, or testing out machinery intended to find the most efficient and cost-effective methods for applying various biocides to the farming landscape. For example, in 1948, when the paint manufacturer Sherwin-Williams considered entering into the 2,4-D market, it sent out questionnaires to several agricultural colleges to gauge how much the compound could increase yields. At least six colleges responded, including CAC, reporting that field tests showed significant increases in barley yields from 2,4-D. One year later, CAC conducted research on sugar beet herbicides using the grass killer Propham at industry request. In 1952, USDA scientists set aside space at their experiment station in Beltsville, Maryland to investigate whether the fumigant dichloropropene (DD), manufactured by Shell and Union Carbide, could effectively control pests in the soil. Though the *Journal of Agricultural Chemicals* did not report test results, apparently Shell was pleased with them, as suggested by a subsequent company ad in the journal highlighted by insects sitting at “Farmer Jones’” table.
waiting to engorge themselves on his freshly harvested crops. In the narrative below the picture, Shell boasted that its DD fumigants were “backed by State and Federal Recommendations.”

These articles and advertisements illustrate how the relationships within the agro-industrial complex had changed in the post-war era. Prior to the war, industry scientists in fields such as seed breeding and agricultural chemistry developed dependent relationships with their peers in the USDA and experiment stations, as illustrated by the Piedmont’s sugar beet industry (see chapter 4). Though the needs of agricultural corporations such as Great Western Sugar often set the agenda for the type of research to be done, agri-state scientists still conceived and conducted much original and basic research. Further, much of that original research was carried out on fields within the same region where successful results might inform farming practices. For example, in the 1920s and 1930s, federal and experiment station scientists continued to occupy much of their time on the Piedmont performing experiments related to irrigation, crop rotation, and cattle feeding using local sugar beets. Even fertilizers and biocides were often the products of localized, original research geared for farmers in the region. In the post-war era, the chemical industry overwhelmed state-sponsored scientists through the sheer volume of new chemical compounds that promised to dramatically expand yields. As most agri-state researchers had already accepted the primacy of efficiency and production through the embrace of technology as the goal of their labors, it followed logically that they would jump onto the chemical bandwagon. Lacking the financial and scientific resources to develop their own new compounds, they left that to industry. For its part, the chemical industry no longer prioritized collaboration with agri-state scientists, but field trials for an array of biocides and fertilizers. The

37 “Chemicals in Food Production,” *JAC* 3, no. 3 (1948); “Experiment Station Digest,” *JAC* 4, no. 7 (1949); A.L. Taylor, “Chemical Control of Nematodes,” *JAC* 7, no. 11 (1952); “Farmer Jones Sets a Good Table…and Don’t the Insects Know it!,” *JAC* 9, no. 4 (1954).
USDA and experiment stations stepped in to fill that role. In doing so, they became junior partners in the relationship, while original research was conducted in laboratories isolated from the sites of their use.

Since the most ground-breaking work in agriculture was increasingly insulated from the farmers who might potentially use its products, it followed that the chemical industry began to attract the most talented scientific minds. One of those people was Dale Wolf. Seeing the possibilities in selective herbicides, Wolf chose to focus his Ph.D. at Rutgers on weed science, a degree that had as yet not been awarded in the mid-1940s by any American university. While conducting research on weed control at Rutgers – New Jersey’s agricultural college under the Morrill Act - Wolf stated that he performed “a lot of work of work for chemical companies.” According to Wolf, the process typically worked like this: chemical companies heard that “a certain combination of chemicals did ________________, so we have some similar compounds, could you do something with them and see what happens?” Wolf’s research led to a Ph.D. in weed science in 1949 and a faculty appointment. Since Rutgers was just up the road from DuPont’s headquarters in Wilmington, Delaware, Wolf interacted with its researchers more than those from other companies. Consequently, when John Woodhouse, the head of DuPont’s agricultural division, sought to grow its line of herbicides, he naturally wooed Wolf. Offering more money and the opportunity to conduct original research in his area of expertise, Wolf signed on with DuPont. According to Wolf, one of the key factors in convincing him to leave Rutgers for DuPont was that Woodhouse was able to convince him that “the future of research was in industry,” as opposed to agricultural colleges. Less than two years later, Wolf co-authored the pre-eminent textbook on weed science. It became indispensable in the classrooms of agricultural colleges for the next decade. Wolf’s story was by no means unique. According to
Woodhouse, in the early 1950s, when DuPont was looking to expand its agricultural research into pharmaceuticals, the company “raided Yale” to get “a veterinarian, a pathologist, and a pharmacologist.” For its part, Michigan-based Dow lured that state’s pre-eminent weed scientist, Michigan State agricultural researcher Keith Barrons, to head its agricultural division. In the post-war era, it was becoming clear that the science that most informed farming practice had moved away from the farm.  

It was not just geographic distance that was created by moving basic research into corporate laboratories. In fact, the genesis for most research in agricultural chemistry was not at all related to farming. Rather, agro-industry scientists were charged with developing new compounds from among the chemicals a company had on-hand, performing experiments to determine their usefulness and then, if a compound appeared promising, designing safe and profitable methods for manufacturing it. For example, DuPont was the nation’s largest manufacturer of wartime ammonia. Since ammonia was one of the best suppliers of readily available nitrogen for plants, the company developed nitrogen-based fertilizers. Later, its scientists discovered that herbicides could be produced from urea, an ammonia-based product often used to supply cattle with protein. Dow possessed comparatively little ammonia, but plenty of chlorine, a base compound contained in both 2,4-D and DDT, and an additive in some fumigants. So, its lab chemists concocted profitable agricultural compounds from chlorine.  

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38 John Woodhouse, interview by Hounshell and Smith, (11 October 1982) and Dale Wolf, interview by Hounshell and Smith (8 October 1986), Hounshell and Smith Oral Histories, Hagley Museum and Library Archives (Hereafter Hagley Archives); Acc. 1878, Box 2; Gilbert H. Ahlgren, Glenn C. Klingman, and Dale E. Wolf, *Principles of Weed Control* (New York: Wiley, 1951); "The Dow 2,4-D Story," Post Street Archives, CHF Archives, Box 1, Folder 2.

39 This is a simplified version of the protocols used in manufacturing agricultural chemicals. Most new compounds never made it to market due to unsafe levels of toxicity or difficulty in manufacturing a profitable product. But, the salient point is that research was disconnected with the practice of farming.

40 Chaplin Tyler, interview by Hounshell and Smith, (7 October 1982), Hounshell and Smith Oral Histories, Hagley Archives, Acc. 1878, Box 2.
is debatable whether all of these new chemicals were beneficial to farming. That depends entirely on what criteria one employs to evaluate benefit. However, there is no question that agricultural science was increasingly being performed by those with little or no personal connection to the land on which their products were employed. Moreover, those who developed the new chemicals were not charged with evaluating their specific uses. Much of that perfunctory research was being farmed out to the USDA and agricultural colleges. But, the intellectual center of agricultural research had moved to distant laboratories where corporate profit informed research imperatives.

There were a few within the agro-industrial complex who questioned the dominance of industrial chemistry in agriculture. Stanley Freeborn, the Dean of the College of Agriculture for the University of California at Davis, was one of them. Though Freeborn fully embraced the adoption of agricultural chemicals, he questioned whether experiment stations were advancing agricultural science by focusing the bulk of their energies on testing industrial products. In 1948, Freeborn claimed that experiment stations do “a lot of empirical fumbling that masquerades as research.” According to Freeborn, if the goal is to synthesize products to kill insects and fertilize the soil, then more basic research should be conducted on subjects such as toxicology and insect ecology. Experiment stations should not just be asking whether a particular biocide killed an insect, but how it operated in the insect body to do so. Four years later, Connecticut chemist Leonard Wickenden voiced a more biting critique. In the midst of Congressional hearings over regulating pesticide residues, Wickenden accused experiment station employees of enriching themselves at farmers’ expense. Instead of supporting the needs of sound and productive farming, Wickenden claimed that agricultural professors at state colleges were “employees” of agro-industry. Wickenden proposed that agricultural advocacy required legislation barring
employees at a land grant college from receiving compensation from the chemical industry.

Wickenden was also one of the few figures in the 1950s who tied farming to environmental values when he claimed that all of the synthetic fertilizers being used by farmers were polluting watersheds, washing farmer profits downstream with them.\(^\text{41}\)

When it came to questioning the role of chemicals in agriculture in the 1950s, Wickenden was certainly in the minority among agri-state scientists. In 1952, Food and Drug Administration (FDA) Commissioner Charles Crawford argued, “it is well recognized that the use of some poisonous or deleterious substance is required in producing crops.” The fact that the vast majority of those “poisonous substances” were not in use ten years prior to Crawford’s statement leads us to question what sort of farming was even possible then. His statement is even more prescient when we consider that his agency, the FDA, was responsible for determining whether a chemical compound was a human hazard prior to approving its manufacture and sale. This is not to imply that Crawford should have opposed the use of chemicals, but to suggest that we might expect him to be a voice of caution. That year, Stanley Freeborn, though critical of experiment station research, argued that “wise and productive use of chemicals is of prime necessity and unavoidable,” and “vital to our national economy.” Displaying the same long-term memory problems as Crawford, he claimed that without modern machines and chemicals, “our American agriculture would be out of business or reduced to peasantry.” In 1956, USDA entomologist George Irving presented similar dire predictions if chemicals were abandoned, claiming “it has been estimated that insects take more production of our soils than man…if left uncontrolled, they would take at least half the average production of the U.S. acre. I’m not sure they wouldn’t take it all.” Striking a more subdued tone as befitted

his position as Assistant Secretary of Agriculture, Earl Butz argued in 1956 that chemicals had enabled farm productivity to increase by 35% since 1945. By the mid-1950’s, scientists and representatives within the USDA and the FDA seemed to be parroting the same argument put forth by the agricultural chemical industry ten years previous; namely, that without chemicals, farms would be overtaken by hordes of insects, ruining crops, stock, and livelihoods. By contrast, they argued, chemicals were indispensable for productive farming. One is led to wonder how American agriculture survived without them.

In an era where agri-state scientists performed little research on environmental harms from chemicals, the arguments of Butz, Irving, Freeman, and Crawford carried the day. From 1950-1951, at Congressional hearings on pesticides chaired by Congressman James Delaney of New York, representatives from throughout the agro-industrial complex, as well as independent scientists and researchers came forth to give testimony. Their statements amounted to a hefty 2,700 pages of testimony. The Delaney Hearings presented in microcosm a fundamental failure in agri-state research. While various health officials, scientists, and medical doctors came forth to describe troubling symptoms that they attributed to exposure to biocides, the value of their testimony was consistently called into question by the dearth of actual studies that proved linkages between chemicals and ailments. For example, Morton Biskind, a physician and former pharmacologist at Case Western University, claimed that as a result of DDT exposure, his patients experienced dozens of ailments ranging from nausea, to abdominal pain, involuntary twitching, and unexplained psychological effects. However, Biskind was largely dismissed because he could not point to a single study that provided definitive linkages. Evidence of harm was largely anecdotal, and the committee wanted clinical proof. By contrast, representatives of the chemical industry offered clinical evidence of chemical benefit in spades. Based on their
work and the field trials conducted by agri-state researchers, they could prove that their products vastly expanded crop yields, and they could cite eye-popping statistics on the economic damage caused by insects and weeds, claiming that only chemicals made it possible to minimize such damage. They admitted that chemicals were poisonous but claimed that they were safe when properly used, placing responsibility for any harm from them on the well-informed user. While the Delaney Hearings resulted in compromise legislation that established tolerance levels for pesticides, they were largely ineffective at exposing environmental harms.  

Wickenden’s earlier claims that agri-state researchers were largely employed by industry contained some merit and were fleshed out in the relationships between Colorado Agricultural College and industry. Consider agreements between CAC and Great Western Sugar. Beginning in 1958 and continuing into the 1970s, Great Western made agreements with several departments at CAC to carry out “research relative to control of insects and weeds in sugar beets.” The 1968 version of that contract stated that Great Western would pay a total of $24,700 to the departments of agronomy, plant pathology, agricultural engineering, entomology, and farm counseling and extension services for determining the relative value of weed control using mechanical and chemical methods. Additionally, those departments agreed to cooperate and share their findings with USDA plant pathologist and weed scientist, Edward Schweizer. According to the details of the agreement, CAC devoted four acres of its Rigden Farm to these sugar beet investigations. Researchers applied 400 pounds of synthetic, nitrate-based fertilizer and 150 pounds of superphosphates prior to planting. Using modern injectors attached to tractors, researchers were to inject several herbicides into the soil to see how they interacted with fertilizers. Once stands of sugar beets emerged, weed scientists applied additional herbicides,  

42 A summary of the comments on pesticides during the Delaney hearings is provided in Davis, Banned, 116-152.
and entomologists then sprayed and scattered both commercial and experimental insecticides in granule and emulsified form. Agricultural engineers had the primary task of cultivating the sugar beet crops in the hopes that the best machinery, calibrated to the crop’s needs, would “produce a satisfactory beet crop without any hand labor…through the best use of herbicides, mechanical devices, and management practices available.” The details involved in carrying out the agreement were managed by CAC Extension Director, Lowell Watts, and signed by the heads of each department receiving money.  

Money for this sort of research also came directly from the federal government. During the 1950s and 1960s, the Federal Extension Service (FES), responsible for the oversight of agricultural extension programs throughout the nation, earmarked annual funds for extension scientists at CAC to conduct research on the use of existing agricultural chemicals. During the 1964-1965 year FES allotted $27,000 to CAC for this purpose. Of those funds, $14,500 were reserved to pay for an entomologist, “or other qualified specialist,” and $8,500 were intended for a part-time research assistant and full-time project secretary. Though the agreement did not specify the use of any particular biocides, it did specify project goals. Those objectives included developing procedures for “analyzing interpreting, localizing, duplicating, and disseminating chemical information rapidly,” and coordinating the efforts between the chemical industry and agri-state scientists. The 1964 agreement implied that such arrangements between FES and CAC had been in operation for several years as it described their “continuing interest in strengthening programs in agricultural chemicals,” and that extension researchers at CAC had “made special

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efforts to conduct a strong educational program on agricultural chemicals.” It was clear that federal and industry funds were essential for biocide research and dissemination.\textsuperscript{44}

Robert Zimdahl, Emeritus Professor of Weed Science at CAC is one of the researchers at capable of explaining the philosophical and contractual relationships between agri-state and industry. Zimdahl was raised in upstate New York and studied dairy husbandry in the 1950s at Cornell in the hopes of becoming a dairy farmer. He became a county extension agent in New York’s Hudson Valley in the late 1950s and then partnered with a friend in a business enterprise that involved spraying herbicides on crops for local farmers. Zimdahl became familiar with sugar beets when he returned to Cornell to complete a master’s degree in Weed Science, employing $7,500 annually in funds from wealthy industrialist, Henry Stack, to study how wheat competed with sugar beets in the fields of the region. As Zimdahl points out, that funding could just as easily be attributed to the soda giant, Pepsi, since that company had recently invested millions of dollars in beet sugar refineries in upstate New York. Stack hoped to profit by growing the beets that would supply Pepsi with its sugar. Though the venture failed it propelled Zimdahl to a Ph.D. program at Oregon State where he studied the rates at which certain herbicides degraded in the soil. Upon completion Zimdahl was faced with the same dilemma as Dale Wolf twenty years previous – work at a chemical company or a university. Despite more lucrative offers from Monsanto, Shell, Diamond Alkali, and Geigy, Zimdahl chose a faculty position at CAC in 1968, in part because of its location near the Rocky Mountains. During his initial years at CAC, Zimdahl received research funding from Great Western Sugar as well as $5,000 from Coors to complete a study of how herbicides could kill off the wild oats that

\textsuperscript{44} Lloyd H. Davis, administrator for the Federal Extension Service to S. Avery Bice, Associate Director of the Extension Service at CAC. 11 June 1964, Files of Lowell Watts, Box 167, Folder: Agreements: Agricultural Chemicals, FES and USDA.
threatened the barley used by Coors to brew its beer. Describing the nature of his research, Zimdahl explained, “it was interesting work, but it was not based on some fundamental hypothesis…. Back then it was a lot of testing of the big herbicides (such as) 2,4-D, atrazine, and dicamba.”

If Zimdahl’s critique of conducting field trials for industry was correct - that they lacked fundamental scientific hypotheses – then why would a professional scientist choose to devote so much time to them? According to Zimdahl, money played a central part. While plenty of money flowed into university coffers through formal arrangements between industry and the institution, as illustrated by Great Western’s agreement with agricultural extension at CAC, more money found its way into the hands of CAC researchers when agro-industry contacted scientists directly. According to Zimdahl, representatives of a chemical company would “show up at your door and say that we have this product and we would like to have you test it…go out and spray this stuff on these crops at this rate at this time and tells us what happens. Then tell us what it does to this crop and what it does to the weeds…and they’d give you money.” Zimdahl went on to describe how two of his colleagues, plant pathologist Jess Fults and weed scientist Gene Heikes cultivated relationships with chemical companies that underwrote much of their work. That money typically came with a significant carrot. Industry was generally not interested in an itemized list of how their funds were spent, as long as the research was conducted professionally and completely. Consequently, researchers commonly applied excess funds to their own research. If a researcher wanted to hire a graduate assistant and the funds were not forthcoming from the university, then chemical research could pay the tab. Or, as Zimdahl pointed out “you

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45 Robert Zimdahl, interview by author, 14 June 2016.
needed some dependence (on industry) to gain some independence. If you wanted a gas chromatograph, you’d better find some money.”

The same funding from chemical companies that presented a research carrot was also a stick. Zimdahl explained that it was not really possible for a weed scientist or an entomologist to succeed professionally aside from cultivating relationships with industry. In weed science, there was no funding available for any kind of research other than that which employed chemical herbicides. According the Zimdahl, had he chosen any sort of “alternative agriculture..., I would have failed because there was not any money for that kind of agriculture.” So, a sort of path dependence developed whereby the pre-dominance of biocides in agriculture since World War II, and the money that the chemical companies brought to the table pre-determined the available options for those in agricultural research.

On the Colorado Piedmont, evidence of how farmers and agri-state scientists embraced the new chemical agriculture is plentiful. A brief examination of statistics and the work of CAC is instructive. While statistics for the Piedmont are spotty, a smattering of data appears for the state of Colorado that correlate to the region. By 1948, 30% of plant nutrition in Colorado was coming from fertilizer. In 1952, the state was using over 6% of the nation’s total supplies of the related herbicides 2,4-D and 2,4,5-T. As the state’s most productive farming region containing its most expensive farmlands, it is likely that chemical applications for the Piedmont were high in proportion to the rest of the state. The extent to which CAC was involved in testing the new biocides and fertilizers is illustrated in an 11-page experiment station report issued in 1957. The

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46 Gas chromatographs are used to separating and analyzing compounds within a mixture, especially useful for agricultural scientists working with chemical compounds.

47 Zimdahl interview.

48 2,4,5-T is a similar chlorinated chemical compound to 2,4-D, but was less selective. So, rather than use it on pasture and crop lands, it was applied more along fence-lines and rights of way due to its more vigorous weed-killing traits. See “Experiment Station Digest,” JAC 4 no. 7 (1949); “Regional Distribution of Pesticides Used in Crop Years, 1950-1951,” JAC 7, no. 7 (1952).
report lists 69 different chemicals compounds that had been field-tested in the region. Soil fumigants included chlorine-based products from Dow and Shell such as chloropicrin and Shell DD. The report touted 2,4-D’s use as a quick fix fumigant that might not kill all insect pests, but dissipated in the soil quickly, and thus facilitated quick planting following its use. The same chemical was tested in spray form and recommended to farmers seeking to profit off the potentially high yields of the new hybrid corn. There were also chemicals that had been specifically tested for their ability to control grasses in sugar beet fields such as Propham, and Dow’s new weed killer called Dowpon. CAC researchers even tested lead arsenate, a throwback to the pre-war days, in combination with other biocides. The report made it clear that these field tests were ongoing, as the report described several biocides as experimental. Most chemicals contained a list of the forms in which they were available, primary uses, and recommended application. While this report does not present direct evidence of the kind and quantity of use for each chemical, it demonstrates that CAC conducted extensive field trials for industry, and encouraged farmers to utilize the new chemical tools at their disposal.49

Of the various biocides that appeared on the Piedmont after World War II, none received more advanced publicity than dichlorodiphenyltrichloroethane (DDT). Chemists synthesized DDT in the 1870s, but was largely left on chemists’ shelves until the Switzerland-based Geigy Chemical Corporation found it useful as an insecticide targeting Colorado Potato Beetles during the 1930s. Geigy representatives approached the USDA in 1942 with the chemical, suggesting it might possess wartime value. Already searching for chemicals that might replace existing crude methods for protecting troops and civilians from diseases, scientists quickly recognized the wartime utility of DDT’s insecticidal properties. Initially used to quell a typhus outbreak in Italy

in 1943 and 1944, the biocide was employed to greatest effect to protect against malaria in the jungles of Southeast Asia in 1944 and 1945. DDT’s success in protecting American troops earned it wartime fame, as it was credited with saving as many as five million lives from lethal diseases. Despite concerns by the Food and Drug Administration that DDT had not been sufficiently tested for civilian use, as well as evidence that DDT could be stored within the body’s fatty tissues, the federal government approved it for most uses in 1945. Field tests conducted by chemical companies and agricultural experiment stations of the USDA and various colleges revealed that DDT’s insecticidal properties could result in significant yield increases in tomatoes, onions, and potatoes. DDT quickly replaced rotenone as the go-to insecticide for protecting feedlot cattle from flies, lice, bedbugs, and fleas. The new insecticide was more effective at controlling insect pests and only needed to be applied every few weeks, rather than every few days. Within just two years after the war’s conclusion, DDT was sprayed on crops, stock, domestic pets, wetlands, urban neighborhoods, and even incorporated into wallpaper formulations. In 1948, there were 20 million pounds of DDT available in the United States. Ten years later that number had increased more than seven-fold.\(^{50}\)

It was clear that DDT had found its way into the mixture of chemicals on the Piedmont quickly after World War II. It was no secret that the Agricultural Research Service (ARS) of the USDA had been researching DDT’s effectiveness as an insecticide since 1943. By early 1945, farmers were already requesting quantities of DDT from the USDA even though it had not been approved for commercial use.\(^{51}\) Though DDT’s dramatic success in the theater of war certainly


\(^{51}\) “Some Facts About DDT Insecticides to Date,” (Washington D.C.: USDA Agricultural Research Administration, 20 March 1945); Russell, “The Strange Career of DDT.”
made the chemical visible, most farmers required more evidence of its efficacy and cost effectiveness. Some of that came from the work of agricultural extension agents on the Piedmont such as Gordon Mickle, Chief Entomologist for CAC’s extension service. In 1946, he cooperated with county agents, USDA officials, veterinarians, the Bureau of Animal Industry, and retailers of chemical products to bring DDT onto Piedmont fields. They completed field tests and demonstrations aimed at killing the insect enemies of potatoes, alfalfa, sugar beets, and corn - all among the most lucrative crops in the region – with considerable success. Extension agents filed several newspaper reports and conducted radio interviews in the midst of demonstrations. While DDT was not the only new chemical on the field test docket, it had received the most advanced publicity.\textsuperscript{52} By 1947, Piedmont farmers were able to consult the results of local experiments and find specific recommendations for the use of DDT. If nationwide trends applied to the Piedmont – and there is every indication that they did – DDT usage increased by a factor of four between 1948 and 1953, and by a factor of seven by 1958.\textsuperscript{53}

No agricultural industry on the Piedmont was better situated to embrace DDT than cattle feeding. By 1945, a growing number of farmers were abandoning their crops for full time cattle fattening. By 1952, beef comprised 80\% of all meat sold by Colorado producers by weight, and Weld County, in the heart of the Piedmont, produced more fattened cattle than any other county in the nation. Statewide, 68\% of all cattle were not on pastures, but confined in tight spaces and fed a tightly controlled diet aimed at fattening them quickly.\textsuperscript{54} At the philosophical heart of confined feeding operations was the belief that feeds produced weight gain most rapidly when

\textsuperscript{52} Other new chemicals tested included benzene hexachloride, dieldrin, and aldrin.
cattle were not expending their energies on activities such as, well, moving. Consequently, energy spent fending off flies, lice, and grubs was energy not spent gaining weight. The problem was exacerbated by the physical layout of the feedlot itself. Put simply, feedlots were pest magnets. When the same animal species – or crop species for that matter – were raised in one locale year after year, their natural enemies concentrated in that same location. Further evidence of this biological rule was in the fact that some insects that target cattle, such as flies, hatched their eggs in cattle feces. Consequently, cattle feedlots were insect breeding grounds. Though pre-war cattle were generally dipped, sprayed, or dusted with formulations of rotenone, that insecticide was effective at controlling insects for only a few days. On the other hand, since DDT was a very stable chemical that did not break down easily, it controlled insects for three weeks, minimizing the labor costs of repeatedly applying chemicals to cattle.55

Knowledge of DDT’s capacity to control insects that targeted cattle often originated from the same cast of characters who demonstrated the chemical’s utility on crops. In 1946, Gordon Mickle and other entomologists from Colorado and Wyoming joined USDA officials from the Bureau of Animal Industry to plan demonstrations for the following year. To attack a lice problem that was prevalent on the Piedmont, they planned to dip 15,000 cattle in DDT solutions in 1947. To announce these demonstrations, they advertised on a Greeley-based radio station. They likely modeled their DDT demonstrations after those being performed in Kansas in 1946 where the U.S. Bureau of Entomology and Plant Quarantine worked with the experiment station at Kansas State to treat thousands of cattle. The cooperating agencies boasted that two men could spray over 300 cattle in a short space of time by herding the beasts though narrow chutes. The sprayers stood on catwalks above the cattle and sprayed their sides and backs. The operators

also sprayed barns, sheds, and any other structures frequented by cattle. The goal was complete control of flies, lice, fleas, bedbugs and mosquitoes. According to the experiment’s authors, cattle treated with DDT gained 73 more pounds than those that did not, at the cost of only 4 to 10 cents per head. Perhaps inspired by that success, the Kansas City Stockyards began a DDT spraying service in 1946. For six dollars an entire train car load could be sprayed before their journey to a feedlot. Many of those feedlots were on the Piedmont. Consequently, the region’s cattle feeders received animals that were remarkably insect free, and they soon discovered that DDT was the cause. It did not take long for many of these Piedmont cattle feeders to become DDT converts. So, whether it originated from industry, experiment stations, chemical retailers, agencies of the USDA, or the bodies of cattle themselves en route to a multitude of feedlots, the DDT gospel spread rapidly. As the confined cattle feeding industry grew on the Piedmont in the 1940s and 1950s, DDT’s presence grew with it.56

The quick adoption and wide proliferation of DDT is the starting point for understanding some of the environmental and cultural consequences of chemicals on the Piedmont. The fervency with which DDT was adopted came despite important warning signs.57 The effectiveness of DDT on malaria-causing insects during the war was largely understood by the public to emanate from the chemical’s insect-killing power. And, while this was true, its greatest wartime value was its persistence. DDT is a member of a chemical group called chlorinated hydrocarbons. Essentially, these compounds contained chlorine atoms – readily available in large quantities after World War II – added to hydrocarbons, the chief components in petroleum and natural gas. Chlorinated hydrocarbons are one of the more chemically stable set of

57 On the quick adoption of DDT despite its dangers see Russell, “The Strange Career of DDT”; Dunlap, DDT, 59–75.
compounds known. Put simply, they could be applied to clothing, soils, and the body and remain effective in controlling insects for extended periods. In wartime, that characteristic enabled DDT to be dusted on soldier’s clothes or even sprayed aerially over an entire island during a military campaign with the knowledge that troops – and civilians – would be protected from malaria-causing mosquitoes. That chemical persistence enabled DDT to retain its lethal power over livestock-targeting insects far longer than previous treatments. What applied to the skin and clothing also applied to bodily organs and the soil. Federal scientists testing DDT in advance of wartime learned that the chemical did not dissipate once it entered the body and was stored in fatty tissues. They also discovered that DDT stored in the fats of mammals soon found its ways into their milk, making the dairy industry a source of potential transmission of DDT into the human body. But the exigencies of war sidelined those concerns in favor of troop protection.  

What applied to the body also applied to the soils. Chlorinated hydrocarbons take several years to dissipate in soils. Consequently, when DDT dusts and sprays were washed from cattle, they fell onto the soil. Repeated applications of DDT only increased that soil presence. Of course, this applied to its use on farmers’ fields as well. Based on DDT’s extensive employment in agriculture from the 1945 into the early 1960s, up to forty pounds of DDT per acre were accumulating in the croplands of the United States. Further, since DDT does not easily penetrate soils, most of the biocide remained within the top several inches of soil. While that generally kept DDT from percolating downward into aquifers and wells, it did not preclude DDT from finding its way into streams and lakes through runoff. There, fish were especially susceptible

59 Russell, “Strange Career of DDT.”
since pesticides such as DDT interfered with respiration at the gill membranes, resulting in death by suffocation. Regardless of the method, DDT accumulated in soils and bodily tissues. By 1963, the average amount of DDT present in human fatty tissues had risen to 12 parts per million (ppm), and the average meal contained 2 ppm.⁶⁰

The ubiquitous presence of DDT provides the starting point for understanding resistance, one of the most important consequences of its use. Within less than three years of the widespread adoption of DDT, the chemical was no longer able to kill certain insects at the same dosages. Consequently, users had to use more of the chemical until either cost or hazard made such use prohibitive. Resistance to DDT was simply one example of species adaptability to environmental change. No individual insect within a species possesses the exact same genetic make-up as another, and so no single individual represents the norm. According to ecologist Robert Rudd, biocides are simply agents that “eliminate the more susceptible individuals.” Those that survive, and are therefore resistant to the chemicals, pass on that characteristic to future generations. Over time, as susceptible individuals are eliminated, resistance to particular chemicals becomes a dominant trait within a species. Entomologists had observed insect resistance to chemicals in the past, but were astonished by how quickly certain species developed resistance to DDT. But no other chemical had so quickly and thoroughly impregnated American agriculture. The speed with which DDT resistance occurred reflected its rapid proliferation, and it was borne out in statistics. In 1948, when it was confirmed that certain species of flies had developed resistance to DDT, 20 million pounds of the product were manufactured. As it accumulated in soils, waters, and bodies, production increased in a decade to 145 million pounds

in 1958. In 1963, at least 30 insect species were resistant. As these statistics suggest, resistance did not present a cautionary tale regarding its use, but rather an impetus to use more.\footnote{Rudd, \textit{Pesticides and the Living Landscape} 141-148.}

On the Piedmont, where DDT had become an indispensable tool for cattle feeders, resistance and the limitations of DDT encouraged the use of greater quantities and varieties of chemicals. One insect that failed to succumb to DDT was the cattle grub. The term refers not to a species but to the larval stage of a heel fly. In that stage, larvae crawl down the hair to the skin of cattle and penetrate the skin, causing considerable irritation. Agricultural scientists found benzene hexachloride (BHC), another chlorinated hydrocarbon, effective at killing cattle grubs. Consequently, cattle feeders applied both of these chemicals. Though resistance developed more slowly than was true for DDT, it was only a matter of time. Consequently, by the early 1950s, cattle feeders were gradually increasing their dosages of both chemicals. But they were also adding other chlorinated hydrocarbons, such as toxaphene, lindane, and chlordane to their arsenal. By 1960, DDT had become just one among many tools employed by cattle feeders. In an article on livestock insect control, USDA entomologist Arthur Lindquist seemed resigned to the fact that feeders would have to rely on a host of chemicals into the future, referring to separate biocides – from multiple classes of chemical compounds - needed to kill fleas, lice, grubs, ticks, flies, and mosquitoes. He then went on to argue that, as a consequence of resistance, experiment stations and the USDA would have to devote increasing time and energy not only to finding new and useful compounds, but to replacing those that were no longer effective. Citing dramatic increases in American meat consumption, Lindquist baldly concluded
that it was right and fair that taxpayers and consumers pay for pesticide research. According to Lindquist, the solution to biocide resistance was more biocides.

Lindquist’s argument demonstrates how completely chemical control of unwanted pests and economic imperatives had come to dominate agri-state science. Each new chemical added to the cocktail necessary to kill cattle-targeting insect pests presented an opportunity to question whether synthetics were the solution. But, there is little evidence that researchers considered other options. For example, cultural and biological control might have included reducing the number of cattle in pens, researching organisms that preyed on cattle pests, or searching for methods to effectively separate cattle from the manure that provided breeding grounds for pests. That biological and cultural methods were not on the agenda suggests that the relatively low cost of chemicals and the economic value of confined cattle feeding trumped alternatives. Moreover, confined cattle feeding was analogous to monocropping. The same organism was grown on one plot of land year in and year out. That organism was chosen for its rate of economic return. Using the land for any other purpose, no matter how ecologically healthy, was akin to reducing one’s income. As long as chemicals such as DDT enabled feeders to monocrop cattle, they continued to do so. By arguing that an ever more exotic cocktail of chemicals was necessary into the foreseeable future, Lindquist implied that alternatives to synthetics were no longer feasible.

Chemical companies introduced subsurface biocides with much less fanfare than insecticides such as DDT, but the processes through which these found their way into agriculture followed a similar pattern. For those growing sugar beets, nematodes presented the most significant subterranean obstacles to a bumper crop. Nematodes are the most numerous multicellular animals on earth. In shape, they generally look like a worm. They are often

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translucent, and most species cannot be viewed by the naked eye. Most, such as the sugar beet nematode, are parasitic and feed off of bacteria and fungi. The sugar beet nematode thrives on the roots of its namesake plant. Prior to the 1930s, the only effective methods for limiting nematode infestations were varying crop rotations and sanitizing tools. From 1937-1947, the growing chemical and petroleum industries contributed four products for soil fumigation that indicated effectiveness for killing sugar beet nematodes. They included products by Dow and Shell featuring petroleum and chlorinated byproducts, including chloropicrin, Shell DD, methyl bromide, and ethyl dibromide. To market their new biocides, the companies received cooperation from the Bureau of Plant Industry (BPI) of the USDA, and they conducted field trials at college experiment stations such as CAC. But, for most farmers, nematode control was not high on their agenda and the new fumigants did not benefit from the advanced publicity accorded DDT. So, in addition to performing field tests, extension agents embarked on an education campaign. This involved demonstrating the damage caused by nematodes under the soil, and demonstrating that nematicides could dramatically increase crop yield values by at least four times the cost of purchase and application. Unlike tobacco and cotton farmers who had to be shown the existence of nematodes, sugar beet growers needed no such introduction. By the end of war nematicides were widely available on the Piedmont, and in common use by the 1950s. Again, the new soil fumigants demonstrated the willingness of federal and state scientists to do field tests for the chemical industry and, in this case, to convince farmers of a problem they were unaware of and an industry solution.

Dow was especially interested in commanding the market for subsurface pesticides on the Piedmont and, in 1956, they introduced a product called Telone. The company claimed that the new fumigant was more effective than previous ones since it contained a higher concentration of dichloropropene, with chloropicrin added to the mix. It could be applied by mounting a tank of the chemical onto a tractor, and attaching tubes and injection shanks to the tank – similar to the equipment used to impregnate the soil with the anhydrous ammonia form of nitrogen. In tests performed by Dow, CAC, and Great Western Sugar, Telone was found to control 90% of all nematodes when applied at 60 pounds per acre. Telone was not, however, a subterranean do-it-all solution since it was ineffective at killing grasses and the seeds of broad-leaved weeds. It should come as no surprise then that Dow enlisted experiment stations and Great Western to conduct field trials of their new pre-emergent grass killer called Dowpon in 1956. Those tests revealed that the use of three pounds per acre could eliminate 25-80% of unwanted grasses. Those that remained could be eliminated with careful post-emergent sprayings. What emerged from these tests was akin to a total subsurface organism-killing and nutrient-supplying system, tested and approved by agricultural colleges and the USDA for the agricultural chemical industry. Several weeks before planting, farmers trolled through their fields trailing fumigants in their wake. Not long after, injection blades were swapped out and replaced by sprayers attached to tanks of Dowpon, and farmers took another pass through their acreage. For good measure, a dousing of 2,4-D might round up the spraying. Once the fumigants had fully impregnated the soil, beet growers mounted cylinders of anhydrous ammonia to tractors, and infused their lands with synthetic nitrogen. Harnessed to a tractor, chemistry had concocted all that a farmer needed in advance of planting.65

Subterranean biocides and synthetic nitrogen streamlined operations while they also forced new dependencies as farmers became chained to the new products to meet market demands. In 1968, Jack Altman, Associate Professor of Botany and Plant Pathology at CAC, had just completed field trials of Telone in sugar beet fields in cooperation with Dow and Great Western. In addition to arguing for the effectiveness of Dow’s biocide, he made broader arguments about how market demands and chemicals had altered agriculture, concluding that crop rotation was no longer sufficient to permit economical beet production. Consequently, according to Altman, “not less than 20-25 gallons of dichloropropene are necessary to fumigate the soil and kill a large share of the nematodes.”66 Great Western followed up on that idea with a series of films intended to support best practices in the beet fields. These grainy films from about 1970 show farmers on tractors performing three tasks utilizing tanks and applicators – inserting Telone into the soil, impregnating fields with an insecticide called Temik, and finally adding anhydrous ammonia. Though the viewer is unable to see which manufacturer synthesized the ammonia, farmers proudly displayed the tanks and packaging of the other two products. Harrison Wellford, author of Sowing the Wind, a book that questioned the proliferation of chemicals in agriculture, called Temik - developed by Union Carbide and field tested at Texas A&M – “one of the most poisonous chemicals ever developed for general use in the United States.”67 There was a double-edged sword in operation here. The same chemicals that expanded productivity made farmers dependent on them.

Those dependencies extended into the soil as well. The goal of fumigation was to kill unwanted insects, bacteria, and fungi. In the process, though, other organisms necessary for plant growth and biotic health were killed, including those responsible for fixing nitrogen in a

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66 Altman, “The Sugar Beet Nematode.”
form plants could readily use. In addition, dichloropropene and chloropicrin – the active ingredients in Telone – inhibited nitrification as well. So, not only had farmers reduced nitrogen in the soil through a decreasing reliance on manure and green crops such as alfalfa, but their employment of soil fumigants had impaired natural processes that promoted crop growth. Further, the nitrogen in synthetic ammonia is not as easily used by plants as that produced through natural processes. Consequently, farmers were encouraged to add ever larger quantities of synthetic nitrogen to the soil to replace that which had been lost as a result of abandoning previous practices, employing fumigants, and adopting a synthetic version of what nature could manufacture. As farmers embraced synthetic solutions to their subterranean problems in the short-term, they interfered with the processes of living organisms that constitute the soil, making the earth dependent on chemicals to continue crop production. Ecologist Robert van den Bosch stated the problem well when he quipped, “pesticides are an ideal product: like heroin they promise paradise and deliver addiction.” That addiction applied to both farmer and field.

Further consequences of these products radiated outward from the soil. Soil sterilization regularly killed off species that targeted the pests farmers hoped to exterminate, and so chemicals often created environments friendly to the same pests that they purported to kill. So, as with resistance, farmers called for greater quantities and newer biocides to control the same pest. Further, surface and subsurface organisms sustain one another. Commonly, insects that started their lives underground worked their way to the surface. Pesticides applied below ground emerged as biological carriers, either as decaying organisms or as living organisms capable of carrying chemical residues far beyond their initial target. Birds are particularly susceptible to

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pesticide residues. Scavengers consumed pesticides present in dead animals, and some species of birds consumed seeds treated with various formulations of the toxic substance, mercury.\(^{69}\) Applications of 2,4-D have been shown to kill lady bug populations. As their populations waned, aphids – the primary prey of lady bugs – infested fields once under control. Various other biocides harmed organisms beneficial to agriculture such as species of bees that pollinate a host of flowering plants. Biocides and fertilizers have been found in every conceivable biological niche, evidence that neither their spatial distribution nor biological consequences could be contained.\(^{70}\)

There is some evidence that responsibility for the biological harm from the post-war explosion of synthetic agricultural chemicals stems from the failure of government to adequately regulate chemicals. In 1954 and 1958, Congress passed the Miller and Delaney Amendments to the Federal Insecticide, Fungicide, and Rodenticide Act of 1947, setting strict residue tolerances for pesticides, and a zero residue tolerance policy for any chemical that was shown to be carcinogenic when tested on animals. Most states passed their own legislation on top of that enacted by the federal government. For example, Colorado banned the use of insecticides during periods when bees were actively pollinating flowers. Though these regulations appeared strict, they were limited in scope. Laws only applied to foods for human consumption. Consequently, the legislation had virtually no impact on the use of fumigants or fertilizers, or any biocide whose primary target was not considered human food. Chemicals could accumulate on other parts of a plant, and in water, soil, or air.\(^{71}\) Essentially, legislation targeted farmers who used too

\(^{69}\) No popular scientific piece had greater impact during the 1950s and 1960s than Rachel Carson’s expose of the harmful impacts of pesticides on birds and other wildlife. See Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin, 1962).


much biocide on fruits and vegetables, or used it at the wrong time, validating industry claims that the only harm coming from pesticides stemmed from improper use.\textsuperscript{72}

A focus on circumscribed regulation fails to address many of the larger institutional relationships that propped up farm chemicals. To understand how and why Piedmont farmers embraced synthetic agriculture, we must return to the agro-industrial complex again. Before World War II, agencies of the USDA and the land grant college had largely accepted the premise that efficiency and productivity through technology in agriculture were unqualified goods. In the 1920s and 1930s they developed cooperative relationships, created professional organizations, and field tested industry products, often in cooperation with agricultural corporations such as Great Western Sugar. Extension agents employed the results of field tests by recommending new synthetic chemicals and fertilizers to regional farmers. During and following World War II, chemical companies, swelling with money and chemical compounds – propelled in large part by the war – descended on state-sponsored research institutions with opportunities to field test their chemical compounds. As 1970s land grant college investigator Jim Hightower argued, scientists, engineers, and economists within state institutions had “both the tools and the inclination to deal with those needs.”\textsuperscript{73} Moreover, since the new biocides and fertilizers promised the very expanded productivity and efficiency that agri-state science had come to support, the arrangement was a natural fit.

It should not have been a natural fit. The chief motive of the chemical industry was profit, and the engines that drove its bottom line were the compounds concocted in self-

\textsuperscript{72} For a thoughtful discussion of the over-application of pesticides, see J. L. Anderson, \textit{Industrializing the Corn Belt: Agriculture, Technology, and Environment, 1945-1972} (DeKalb, Ill: Northern Illinois University Press, 2009).

\textsuperscript{73} According to Jim Hightower, in 1969, only 4.8\% of experiment station hours were devoted to functions that concerned people, while the vast majority of time was devoted to projects that included insect control, the biological efficiency of crops, and management systems for livestock; see Hightower, \textit{Hard Tomatoes, Hard Times}, 26–27, 91.
contained laboratories. Companies such as Dow, Shell, DuPont and others were not concerned about how their products impacted rural life, farmers, or the soils. Further, agricultural chemicals were generally capable of addressing only one isolated part of the farming landscape for a finite period. For example, a fumigant might control a particular insect species for one year, or a cattle rancher’s use of DDT might kill cattle lice for three weeks. But each species quandary required repeated applications of a host of synthetics. Industrial chemistry never provided agricultural solutions that worked within the existing relationships between organisms. On the contrary, its products essentially claimed that chemical properties could supplant biological relationships. Nor could agro-industry products offer permanent gains to individual farmers without repeated and sustained usage. The chemical industry was motivated by profit. Its patrons were not farmers, but consumers, and only repeat customers could satisfy industry objectives. In the end, the only permanence offered by chemical agriculture was in the form of dependency, as the farm became addicted to chemical solutions.

That is not how agri-state scientists viewed chemical agriculture. According to Robert Zimdahl, agricultural researchers at the USDA and at CAC were not concerned with complications such as biocide toxicity, insect resistance, chemical dependency, and biological harm. Though they were aware of them, he stated that they focused on “what we can do, not what we ought to do.” Weed scientists for example felt that they were offering a public service by testing a product to be sure that it was safe and did what it claimed to do. Or, in Zimdahl’s words, “does it work?” Further, agri-state scientists believed that the most significant consequence of their research was the production of more food, and that more food was an unqualified good. It followed that those who questioned the chemical paradigm obstructed food production. Regulators in the FDA and ecologically-minded scientists such as Barry Commoner
and Rachel Carson, who were concerned with chemical harm, hindered the agri-state mission. According to Zimdahl, his colleagues felt that making a moral dilemma out of biocides “does not lead anywhere helpful.”

One of Robert Zimdahl’s professional experiences illustrates the narrow thinking of some of his colleagues. In the early 1970s, Zimdahl had begun to question the pervasiveness of chemicals in agriculture. He presented a paper at a conference for the Weed Science Society of America in Dallas. His paper was titled, “2,4,5-T - A Value Question.” Though 2,4,5-T was intended for use in clearing fence-lines and public rights of way of unwanted vegetation, it was most well-known in the early 1970s as being one-half of the compound, Agent Orange, used to defoliate densely forested areas of Vietnam during the Vietnam War. Though Zimdahl did not advocate for its ban, he expressed concern over its toxicity. When he had finished speaking, Zimdahl gathered his materials and left the room. Waiting outside for him were six weed scientists. After giving him the obligatory congratulations, they pointed to what they felt was the central problem in his presentation. Zimdahl lucidly recalled them stating “…and problem is you.” They went on to argue that, by questioning a proven herbicide, Zimdahl was casting doubt on the tools of their profession and, by extension siding with the “environmentalists” who wanted to take their tools away. Later, when he went to publish the paper on which the talk was based, no weed science journal would publish it. Zimdahl finally published the paper in the Bulletin of the Entomological Society of America.”

By posing a moral dilemma to scientists

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74 Zimdahl Interview.
75 The other half of Agent Orange consisted of 2,4-D.
only interested in whether a particular chemical effectively killed weeds, Zimdahl began to operate outside of the knowledge economy his profession had created for itself.\footnote{Zimdahl Interview.}

By refusing to question their tools, agri-state scientists and officials offered unqualified support for the chemical industry, thereby conflating the prerogatives of industrial capitalism with the public good. In embracing the idea that agricultural chemistry could expand yields, while not questioning the environmental and social consequences of so many of the new synthetics being field tested, the USDA and land grant colleges lost any moral ground on which to question long-term harm – to farmers, consumers, and the land. Moreover, since much of their research operated under the narrow set of imperatives dictated by industry, they lacked the body of scientific evidence that could have enabled them to question the unchecked growth of chemicals in agriculture. From 1945 to 1970, few state-sponsored scientists were conducting studies on the long-term effects of chemicals, or on how agricultural changes were impacting the long-term health of the land and its farmers. According to studies done in 1969, over 90\% of the work done that year by scientists at agricultural research stations focused on how to control insects, increase crop efficiency, and manage livestock. Further, few research projects emphasized any methods other than chemical ones for controlling insect pests. By 1970, agri-state researchers had accumulated an impressive body of work that demonstrated short-term gains from synthetic products in agriculture, but few studies that analyzed how chemicals might impact farmers and the land for any sustained period. It should not come as any surprise, then, that farm practices largely reflected industry prerogatives.\footnote{McWilliams, \textit{American Pests}, 111–193; Hightower, \textit{Hard Tomatoes, Hard Times}.}

Those prerogatives were reflected in a Piedmont agriculture that could no longer sustain itself apart from synthetic means. Crop rotation had formerly played a crucial role in limiting
organisms that attacked specific crop species, by preventing them from accumulating in any specific field. Biocides did not entirely halt crop rotation – though in some cases they did – but they offered chemical solutions to biological problems. Moreover, the logic of chemicals was one of warfare, rather than concomitance. It suggested that insects, fungi, and bacteria were foreign invaders on the agricultural landscape that required eradication, rather than interconnected pieces of a biological web that could be managed to support productive agriculture. If chemistry could supplant biology, so the logic went, then meticulous land management could be made simpler by synthetic products. A sort of “kill and fill” mentality resulted whereby biocides destroyed the perceived enemies of crop production, while synthetic fertilizers such as anhydrous ammonia were employed to add back to the soil what was lost. This could not help but destroy intricate ecological balances. Farmers on the Piedmont formerly relied on living organisms to provide for soil needs. The value in composted stock manure and green crops such as alfalfa was not just in the fact that they facilitated the fixation of nitrogen in the soil, but that they used biological means to do so. Though imperfect, they were practices that could maintain productive agriculture – with minor adjustments - for the long term. As biology was abandoned for chemistry, addiction resulted. Whether farmers chose monocropping, or just abbreviated crop rotations, they created environments friendly for insects that targeted their crops and depleted soils of essential nutrients. Even agri-state scientists generally admitted that insect pests in Piedmont fields were on the increase in the 1950s and 1960s, and were developing resistance to chemical controls. Rather than viewing these developments as an opportunity to question prevailing practices however, agri-state scientists generally argued for more extensive and diversified chemical control to sustain crop yields.\footnote{In 1964, Eugene Heikes, a weed specialist at CAC stated that noxious weeds had increased in 38 out of 40 counties in Colorado. Consequently, Heikes stated that CAC was testing Tordon, a new herbicide to complement} But, it was a sustainability based on
illusion since chemical farming and biological equilibrium were antithetical. Instead, chemical solutions created chemical addictions.

Apart from a fundamental re-orientation in philosophy on the part of farmers and the complex of agri-state scientists and administrators between 1945 and 1970, it is difficult to envision an alternate narrative trajectory. As production and efficiency through technology became the overwhelming metrics by which to gauge agricultural success, and industry science provided the primary means to expand crop production, few institutional voices existed to question the implications of the wholesale adoption of chemical solutions. Chemicals expanded yields cheaply and efficiently. Their quick adoption poured money into industry coffers and attracted top research scientists to their standard. Biocides and fertilizers seemed to be accomplishing the narrow objectives of agri-state science. So it made sense that, as junior partners in the agro-industrial complex, public agri-state scientists largely did industry’s bidding. Further, it should come as no surprise that those same voices generally adopted a sort of historical agricultural amnesia, suggesting that modern farming was only possible through industrial chemistry. Consequently, as evidence of environmental harm and insect resistance accumulated from the late 1940s through the 1960s, state-sponsored researchers ignored or downplayed harms, or blamed them on user error. Agri-state scientists possessed neither the moral authority nor the research resume to do otherwise.

Chemical farming is only one piece of the puzzle that constituted industrial agriculture on the Piedmont, but it impacted the physical landscape of agriculture more than any other. By its very nature, settled agriculture disrupts relationships between organisms, removes vital nutrients from the soil, and puts pressure on ecosystems whose geographies extend beyond those used for

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2,4-D on weeds such as Russian Thistle and bindweed, where 2,4-D was no longer effective (Tordon possessed far higher toxicity than 2,4-D).
food production. These disruptions had always been limited prior to 1945 because Piedmont farmers understood that land stewardship was necessary for long-term farming. Though they largely embraced cash crops, irrigation engineering, and growing for corporations such as Great Western Sugar, success depended on meticulous soil maintenance. Post-war chemicals and the support system that developed around them suggested that industrial products could substitute for stewardship. Biological obstacles could be overcome in chemical laboratories, and, the true measure of land health was found in abundant yields and on well-stocked supermarket shelves. Chemicals suggested that farmers no longer needed to manage nature to make a living because biocides could destroy threatening organisms and then bury the evidence through fertilizers that claimed to replenish all that was lost. Wendell Berry was largely correct when he suggested that chemicals offered “not just ready-made solutions, but ready-made thoughts.” While pre-war farming appropriated the land for human needs, chemicals made the farm an entirely anthropocentric place.

Despite the seeming inertia that biocides exerted in the decades following World War II, it is still possible to imagine a different future. Robert Zimdahl’s career trajectory and evolving thoughts offer food for thought. His simmering doubts about chemicals in agriculture led to an entirely different career trajectory in 1990. That year, he was able to gain university funding to teach a course titled, “Agricultural Ethics,” the first of its kind in the United States. Lacking course materials to teach such a class, Zimdahl wrote the seminal text which attempted to provide a broad framework of values to guide ethical agricultural decision making. For the next seventeen years, that course and the moral dilemmas it posed occupied the lion’s share of Zimdahl’s teaching and research. When I sat down with Zimdahl on June 14, 2016, he abruptly

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80 Berry, “Whose Head is the Farmer Using?,” 19-30.
asked me at one point whether it is possible to remove synthetics from agriculture completely and farm on a completely organic basis.Caught by surprise, I mumbled that I did not think so. Zimdahl responded in disagreement. He argued that the decades of research which supported chemicals in agriculture, including some of his own, had made the synthetically-dependent agriculture we see today. If we invested an equivalent amount of time, money, and research into organic farming, Zimdahl claimed, would it not be possible to achieve it?^81

I want to believe Robert Zimdahl, but I am not so sure if a wholly organic agriculture is possible, or even desirable, especially given his timetable. The revolution in agricultural chemicals that occurred on the Piedmont after World War II did not arise in temporal isolation. It enjoined an industrial transformation that had been occurring long before World War II. For more than anything, the aim of industrial agriculture was to fully harness a biological landscape for market production - to transform land into capital as efficiently as possible. This thinking was present when the Union Colony pooled its resources to start an agricultural colony in 1870. It epitomized the engineering that manipulated water onto farmers’ lands. Profiting from expanding sugar markets motivated the founding of Great Western Sugar as well as its growers’ appropriation of land to grow sugar beets. Market production was key to seeking a permanent base of cheap labor – and eventually mechanizing that labor. Expanded yields per acre motivated the nexus of relationships within the agro-industrial complex, as scientists and industry promised greater productivity, eventually through the proliferation of a host of profitable chemical compounds. By 1970, the agricultural landscape of the Northern Colorado Piedmont was a thoroughly industrialized place. The processes which made it so had been building for a century.

^81 Zimdahl Interview.
Conclusion

At first glance the Union Colony of 1870 and the Greeley feedlots of 1970 present as alternative universes. Upon closer inspection, the Union Colony tells us more about modern Greeley than is initially apparent. While Union colonists originally organized their settlement around cooperative agriculture that philosophy largely disappeared within its first decade, as land speculation, private property, and water rights destroyed what turned out to be a shallow commitment to communal ideals. Nineteenth century Greeleyites remained committed to intensive cultivation. Rooted in a market-based philosophy, intensive cultivation refers to “the application of capital and technology to increase yields on existing land,” as opposed to extensive cultivation which seeks increased yields by acquiring new lands and using existing technology.530 Greeley settlers generally purchased small acreage – typically far fewer than the 160 acres common under the Homestead Act – with the hopes that also building irrigation works and claiming water rights would generate abundant harvests of desirable market crops, and modest amounts of wealth. Along with local boosters and other farmers in the area, they successfully courted railroad interests to gain broader agricultural markets. In the late nineteenth century, Piedmont farmers embraced crop rotations that included nitrogen-fixing alfalfa and raising livestock, largely for the fertilizer that resulted. It was a largely productive and somewhat sustainable agriculture. It is easy to miss that, no matter how sustainable the farming methods, they still reflected the ideals of intensive cultivation. They embraced existing technology. These early Piedmont farmers were using every available resource at their disposal to produce crops on small acreage. The most important resources were productive soils and sufficient irrigation water. Technology largely resided in irrigation engineering.

We should not romanticize these farmers or conflate their philosophy with that of modern day alternative farmers who eschew using tractors or chemicals. Modern farmers who embrace organic methods or resist the use of machines and chemicals are reacting to technologies that were either non-existent or unavailable in the late nineteenth century. In that sense, their rejection of modern methods is also a rejection of intensive agriculture. There was nothing in the agricultural philosophy of Piedmont settlers that suggests anything other than a commitment to intensive cultivation. In fact, there is no reason to believe that they would not have adopted the tools of later generations had they been available at the time.

Industrial agriculture did not replace intensive cultivation; rather it was an extension of it. Using that logic, it makes perfect sense that most Piedmont farmers embraced the economies of scale that resulted from the beet sugar industry in the early twentieth century. After all, sugar beet agriculture required meticulous soil maintenance and offered the opportunity to make more money on existing acreage. Though some farmers may have flinched at the idea of an imported labor force, seasonal labor was necessary to carry on the intensive cultivation they had embraced. Moreover, though sugar beet agriculture reduced farmer autonomy, it also tied farmers closer to market agriculture. After all, few crops could claim to be more joined to consumer markets than sugar. Intensive cultivation maps on top of Piedmont irrigation just as well. Throughout the period under study, farmers continued to seek more water, and not for the sake of new users or just to possess a more secure supply. They recognized that water meant wealth, sizable yields, and the ability to grow each new and more lucrative crop as it became available. The year-round feedlots that materialized in the 1930s took advantage of new feed technologies, more effective insecticides, and the hybridization of corn that enabled it to be grown cheaply and abundantly on Piedmont farms. When Piedmont farmers adopted chemicals as a centerpiece of farm
management, they abandoned former methods, but not prevailing philosophies. At the heart of chemical agriculture was the belief that modest capital investment in technology could minimize human labor and facilitate vastly increased yields on existing acreage. Union Colonists did not have access to the kind of capital that these modern farmers did, nor would they have recognized their machines and chemicals. But they would have identified the philosophy behind it: intensive cultivation.

There is also much continuity in the philosophies that guided agri-state scientists and officials from the late nineteenth century through the 1960s. Their presence on the Piedmont was supposed to be guided by two missions: to support independent farmers and to conduct and promote scientific methods in farming. There is little evidence that the former mission ever drove their work. Instead, if agri-state researchers thought about independent farmers, they generally assumed that new farming technologies universal benefitted all farmers and further, expanded yields on existing acreage was an unquestionable good. In the late nineteenth and early twentieth centuries, prioritizing technology over independent farming was of little practical consequence since most of the research necessary to expand yields had to do with soil maintenance, irrigation engineering, and integrating cattle feeding with crop rotations. Most CAC and USDA research originated on local soils, either on experiment station lands or on the lands of farmers themselves. However, when technology shifted toward machinery and chemicals beginning in the 1920s, agri-state science shifted with it – away from Piedmont farmers and soils and toward agro-industry. This was not so much a modification of philosophy as a change in relationships. Since agro-industry promised greater efficiency and higher yields through broad application of new technologies, agri-state researchers naturally gravitated toward industry-generated research and away from Piedmont fields, eventually conducting their field
trials. This should not come as any great surprise since supporting technology in agriculture had always been central to agri-state’s mission.

It is possible to imagine other outcomes. Prior to the 1920s, the vast majority of agricultural research on the Piedmont integrated well with the form of farming that already existed, focusing on soil maintenance, crop rotation, and mixed farming. Regardless of philosophy, the same research that encouraged higher yields, also supported sustainable farming. When the products of agro-industry became readily available on the Piedmont, the complex of agri-state researchers and officials failed to question the basic assumptions inherent in their philosophy. New technologies did not work with existing forms of agriculture; they supplanted them. They suggested that capital investments in machines and chemicals would make traditional farming irrelevant. The new products boldly stated that it was not necessary to use alfalfa and manure to replace essential nutrients, and all hand labor could be replaced by precise machinery and biocides. Farmers did not need to wait for an insect outbreak before using insecticides, since the new products claimed that they could kill the offending organisms before they had a chance. Moreover, lethal chemicals precluded farmers from worrying about the unwanted pest regimes that could result from monocropping and year-round feedlots. On the Piedmont, the new agriculture suggested that soil could simply be a platform for cattle to stand on or, as historian Colin Duncan has aptly put it, “merely a physical support system for (plant) roots.” The new agriculture did not assert that soil could be more productive through technology, but that the soil – as an interconnected biological unit – could be made irrelevant through technology. These revolutionary transformations in agriculture demanded a radical re-orientation in agri-state philosophy and research agenda. Until the 1960s, when ecologists began to question modern agricultural methods, the USDA and agricultural colleges possessed the only
complex of publicly-minded researchers within agriculture in a position to question the long-term harms of the new agriculture. However, one of the most glaring features in agri-state research was its failure to conduct basic research related to modern industrial agriculture. Virtually no work was done by scientists to examine how chemicals impacted relationships amongst organisms in the soil, or the influence of machinery and chemicals on local watersheds. Researchers were concerned about the fact that chemicals killed insects, but conducted little research into insect toxicology, or why certain populations developed resistance. The agricultural transformations that occurred largely through the middle third of the twentieth century failed to inspire a corresponding change in philosophy within state-sponsored science.531

Though state sponsored science failed in its role as guardians of the independent farmer, if we focus too intently there then we miss the larger goals of industrial agriculture and the roles played by farmers, industry, and consumers within it. At the heart of industrial production, whether in a factory or on the farm, is the desire to rationalize the factors of production. This is a more complicated task on a farm than in most factories. The majority of factories manufacture consumer goods that are the product of minerals, synthesized chemicals, and machinery. Such sites of manufacturing are generally located in urban areas where a critical mass of laborers are available to work for wages. In traditional farming – including farming on the Piedmont prior to World War II - production depended largely on biological and climatological factors for success. Healthy soils were the product of a complex interdependency of organisms and minerals. Farmers had to maintain enough diversity of crops and use on-the-farm resources to replenish nutrients that intensive cropping removed. There were always limits to what could be grown, and farmers ignored the complexities of their land at their own peril. But, despite the most

meticulous management, in any given year, unusual weather, pest infestations, or lack of available water could curtail production. Complexity and a degree of unpredictability dulled efforts to rationalize production. Labor also curtailed efforts to industrialize agriculture. It was never easy, even for corporations like Great Western, to attract a reliable and consistent seasonal labor force willing to do hand labor only during periods when crops required it. To supply a demanding consumer market with human food and animal feeds, farmers and industry developed ever more complex methods to simplify or supersede biological relationships. In that sense, intricate irrigation canals, storage reservoirs, and trans-basin diversion projects were attempts not just to make more water available, but to make it available on-demand, thus rationalizing an unreliable resource. Chemicals and machinery were complex products of engineering and lab science, and relied extensively on petrochemicals for their development and use. Yet, on the farm, chemicals and machinery were employed to minimize the vagaries of seasonal hand labor, reduce reliance on draft horses, and eradicate any reliance on the biological relationships formerly necessary for food production. Rationalizing production required simplifying the agricultural landscape, and that could not be done without doing violence to biological relationships.

Simplified landscapes have also altered the human landscapes of the Piedmont as well. Since World War II, chemicals, machinery and water rights have been the most instrumental factors in farming success. All of these require heavy capital investments. Hybrid corn cropping after the war on the Piedmont presents an instructive example. Corn required more water and biocides than any staple crop that preceded it. Moreover, market farmers could not grow it without tractors, implements and petroleum. Farmers without sufficient water rights – even with the new water from the Colorado-Big Thompson Project – or the ability or inclination to invest
in machines and chemicals could not grow the most lucrative crop. Statistics from 1933-1959 show that in Weld County, the most productive county on the Piedmont, farm size more than doubled, as wealthier farmers bought out those who could not afford to stay in business. In her seminal work on industrial agriculture, Deborah Fitzgerald explains that new agricultural technology always began as something that a few wealthy farmers purchased to make their operations more efficient, but quickly became tools of necessity that forced some farmers to go deeply into debt or get out of farming.

There is no easy answer to the quandaries posed by industrial agriculture in the modern world. While my sympathies are with agricultural philosophers such as Wendell Berry who believe that it is possible to return to a pre-industrial agriculture whose primary energy sources are provided by draft animals, my idealism is tempered by what I know to be possible. If the modern history of Piedmont agriculture offers any wisdom for the present, it is that our agriculture must be characterized by restraint, patience, and esteem for the values of local peoples, and local production and consumption. Land ownership, farmer income, and food production on the Piedmont was at its most stable from 1900 to 1930 when small acreage, mixed farming, and minimal use of technology were employed. The largest tragedy of that era was the importation and marginalization of seasonal laborers. However, if reformers such as Thomas Mahony were correct, the profit margins achieved by Great Western and its growers could have supported living wages for hand laborers without altering farm production. That same period was also characterized by the use of local feeds, and the recycling of most crop wastes back into

533 Fitzgerald, *Every Farm a Factory*, 184-190.
the soil. While all farming disrupts ecological relationships in the very act of inserting a plow into the soil, farmers on the Piedmont were limited largely to a form of farming that relied on the resources of their own farm, or resources within a fairly small radius of their property. The most damage to human values and ecological relationships occurred during the immediate post-World War II era when farmers and agri-state scientists adopted industrial products without questioning their long-term harms, homogenized what had previously been a diverse agriculture, and embraced unfamiliar and extra-local inputs. Healthy agriculture – industrial or otherwise – is marked by respect for the complexity of biological relationships in the land, attention to how crops, animals, and their byproducts can be consumed and re-used locally, restraint in the use of all technology, and a larger society that respects the foregoing goals. These are objectives still worth striving for.
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