MAKING THE WEST MALLEABLE: COAL, GEOHISTORY, AND WESTERN EXPANSION, 1800-1920

by

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DEDICATION

For Elizabeth, our Baby, and Huckleberry, with Love.

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ABSTRACT

Historians have long understood the West as a region shaped by aridity. Yet by analyzing scientific imaginations as they interacted with the materiality of western landscapes, this dissertation argues that the history of the American West was equally influenced by the discovery of the watery deep past of its paleo-landscapes. The physical geography and remnant resources generated through geologic time in the American West decisively influenced western settlement and the advancement of American science in the late-nineteenth and early-twentieth centuries. Through government reports, scientists breathed new life into the ancient denizens and environments of the West. Where others saw an eternal and timeless desert, many scientists saw a plastic and ever-evolving environment. Boosters absorbed the authority of their science to lend credence to visions of a plastic West that would once again become a verdant paradise. Imagined vibrant paleo-environments portrayed once-and-future fertile landscapes that overrode the dominant perception of the American West as arid and hostile to life. With the power granted by coal paired with new technologies, and the Eden-like scientific visions of a former fertile West, vast human-induced climatological changes became an empowering possibility to a nation driven to settle the West. A “paleo-restorative dream” emerged in which the West—by the agency of humans—would return to ancient Edenic landscapes. Indeed, the geoengineering that pervades contemporary discussions concerning climate change and drives hopes to terraform Mars had their origins in the nineteenth century drive to recreate the American frontier.

INTRODUCTION

On August 6, 2012, after travelling 8½ months through the cold vastness of space, NASA's "Curiosity" rover landed on the dusty surface of Mars with the designed purpose of ascertaining the planet's habitability. Luckily for those hoping to one day colonize Mars, the instrument-laden rover successfully landed in a region once occupied by a fresh-water lake known as the Gale Crater [Figure 1]. In 2013, it was widely reported that in this lake there was hope for understanding the deep past and future of the now barren planet. The *New York Times* stated that the lake existed around 3.5 billion years ago and could have "lasted for hundreds or thousands of years, and possibly much longer." A geologist working on the Curiosity mission called the "whole thing…extremely Earthlike," and noted that hypothetically "if certain microbes like those on present-day Earth had plopped into that ancient Martian Lake, they would have likely found a pleasant place to call home."[1] These recent developments in space exploration have brought this frozen desert-planet back into the popular consciousness. But the habitability of the red planet has captivated Americans for over a century.

Today's discussions of terraforming Mars have a lot to do with our current environmental and climate change conundrums. Since Mars was so pleasant once, the barren waste of a planet could be reclaimed. With the data that is being gathered by Curiosity, NASA could work towards terraforming the desert-planet. NASA's Mars Team website proclaims the possibility of creating a new Earth by digging into Mars' deep past.

[1] Kenneth Chang, "Ancient Martian Lake May Have Supported Life," *The New York Times*, December 9, 2013.

> Terraforming is the process of transforming a hostile environment into one suitable for human life. Being that Mars is the most Earth-like planet, it is the best candidate for terraforming. Once just the subject of science fiction novels, it is now becoming a viable research area. The famed astronomer and Pulitzer prize winner, Carl Sagan, says that there is enormous promise in the search for ancient life on Mars. If life was once sustainable on Mars, it is important to know what caused Mars to evolve into the cold and lifeless planet it is today. With this knowledge, we can terraform Mars by reversing the process.[2]

By tracing Mars' geological history, NASA scientists make clear that they believe terraforming is technologically feasible. They assert that while it will not be easy, it is "technologically possible at the present time to create considerable global climate changes, allowing humans to live on Mars."

Furthermore, fueled by an intense faith in technological fixes to environmental problems, the NASA scientists claim, "[t]his research has strong environmental implications for Earth. What researchers are trying to do involves global warming, a sort of greenhouse effect on the cold planet Mars. Scientists may be able to test their hypotheses about global warming in their attempts to elevate Mars' surface temperature." Once these technological fixes prove successful on Mars, "they may be applied to our own planet in an attempt to reverse environmental damage done by pollution and deforestation."[3] Not only could we create a *new* Earth by tracing the geological history of Mars, but we could fix all of the problems that have developed on the *original*.

How could this immense task of reclaiming a planet be accomplished? The answer, given by NASA planetary scientist Chris Mckay in a *National Geographic*

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[2] "Terraforming Mars," Mars Team Online: NASA, accessed June 14, 2014. http://quest.nasa.gov/mars/background/terra.html.
[3] "Terraforming Mars."

article, resounds with the familiar hopeful tone once found in the nineteenth-century American West. "You don't build Mars," McKay says. "You just warm it up and throw some seeds."[4] Rain will simply follow the plow on Mars. The article concludes that, "[a]ll the planet needs to recapture its salad days is a gardener with a big budget."[5] With enough money and technological enthusiasm, it will be possible to reclaim Mars and terraform it in the image of our Eden – Earth.[6]

NASA scientists believe that the fourth rock from the Sun can escape its poor reputation as a cold and barren waste of a planet. Like the many emigrants that pushed forth into the western frontier, there are at least two hundred thousand people lining up to have the opportunity to watch a Martian sunrise over Olympus Mons while sipping coffee on a grassy knoll.[7] But first, humanity must reclaim the desert planet just like Americans attempted in the arid regions of North America. Today's discussions concerning terraforming Mars serve as an almost perfect analogy for those that characterized the American West during the late-nineteenth and early-twentieth centuries.[8] The commonality lies with the late-nineteenth century fossil-fueled faith in

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[4] "The Big Idea: Making Mars the New Earth," *National Geographic*, accessed on June 21, 2014. http://ngm.nationalgeographic.com/big-idea/07/mars.
[5] "The Big Idea: Making Mars the New Earth."
[6] David Noble claims "modern technology and religion have evolved together," and "[i]n America as nowhere else before or since, the useful arts became wedded to Adamic myths and millenarian dreams." Furthermore, Noble notes the religiosity of the space program in the United States.; David F. Noble, *The Religion of Technology: The Divinity of Man and the Spirit of Invention* (New York: Penguin Books, 1997), 5, 88, 89, 115-143.
[7] Elizabeth Landau, "200,000 People Apply to Live on Mars," *CNN*, December 10, 2013.
[8] David E. Nye, *America as Second Creation: Technology and Narratives of New Beginnings* (Cambridge, MA: MIT Press, 2003), 289.; For an excellent exploration of the uses of historical analogy, see: Bruce Mazlish ed., *The Railroad and the Space Program: An Exploration in Historical Analogy* (Cambridge, MA: The MIT Press, 1965).; The ocean has also been seen as a new frontier of abundance. See: Helen M. Rozwadowski, "Arthur C. Clarke and the Limitations of the Ocean as a Frontier," *Environmental History* 17 (May 21, 2012): 578-602.

science and technology as tools to master the natural world and the use of the material remains of geologic history to inform the present and future.

NASA's exploratory mission to Mars and the institution's high hopes for terraforming the planet were inspired by experiences in the American frontier. Space has, therefore, been fittingly termed the "final frontier." Instead of looking up and out into space, the spurs to geoengineering on the planetary scale should be sought beneath the western landscape. During the nineteenth century, the nation's frontier was extended in time and space, just as what some historians have termed *Homo sapiens industrialis* explored beneath the surface of the West.[9] This new arena of study opened up opportunities to imagine and create human-centered environments. The American West was where a national identity was forged, but it was not just through the horizontal movement and "free land" suggested by Frederick Jackson Turner, but also vertical exploration into what I call the "subterranean frontier."

We cannot appreciate the fullness of America's history without addressing the deep history of the American West. This dissertation reveals that beneath the American West lies the history of the nation. North America's geologic history (or geohistory) shaped the nation's character and ambitions. In the process of interpreting these materials and imagining their potential significance, Americans and their material environment co-constructed the active power to reshape the continent. In particular, two objects from the geologic past that were formed from ancient environments, have underwritten America's

[9] Brett L. Walker, *Toxic Archipelago: A History of Industrial Disease in Japan* (Seattle, WA: University of Washington Press, 2010), 6.

presumed abundance and destiny.[10] Fossils demonstrated the region's malleability by providing insight into the changing nature of the West. Coal granted the power to impose desirable environments picked from the past onto the current landscape. Interacting with these artifacts has bound Americans ever more tightly to the history of the Earth and the fate of their fellow creatures through the global carbon cycle. By feeding Promethean desires, they have helped to form the structure of America's exceptionalism and ravenous energy consumption. Recognizing this fact forces a revision of the frontier and aridity theses of western history, and encourages environmental historians to revisit their deep western heritage.

Analogy, Imagination, Stories, and Material Agency in American History

This dissertation takes seriously the socio-cultural and mental components of material agency. Analogies, imagination, and stories in history and science help humans grasp the unfamiliar and understand the physical world that entraps their minds. For example, I examine the use of analogy by scientists and western boosters in imagining and describing geologic history and in telling stories to predict a possible parallel with the former condition of the land. Historians, as well as scientists, use these three tools to understand the past in terms of the present and the future. This was particularly true in the subterranean frontier of the American West.

[10] For a pioneering study of abundance and American identity, see: David M. Potter, *People of Plenty: Economic Abundance and the American Character* (Chicago, IL: The University of Chicago Press, 1954).

Historical analogies are useful to understand the nature of the present through the past.[11] They allow one to grasp onto a familiar concept in order to pull oneself into novel or uncomfortable situations.[12] Analogy served to ease the hard-to-grasp visions of deep time and drastic environmental change, as well as provide an archetype for the future. Also, familiar analogies to tropical environments were used to describe paleo-environments and then those very analogies were used to overcome the desert-like character of the West. Imagined analogies that familiarize and provide comfort can be forcefully imposed on the present and future.[13] The West was a garden, and therefore it would be a garden. The transcontinental railroads helped to promote the idea of a malleable West directly by advertising it in their booster literature, and indirectly by being the model technology for the mastery of the natural world.[14]

Humans can create entirely novel environments using their remarkable grey matter and then act on that imagination to make it happen in the real material world. As will also be discussed below, the measured efficacy of these imagined environments on the material world is dependent on power, or energy. The greater the power of the actor, the grander the impact of their imagination.[15] Imagining new environments came with telling new stories about oneself and society. A future and past had to also be invented to

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[11] Douglas R. Hofstadter, "Analogy as the Core of Cognition," in Dedre Gentner, Keith J. Holyoak, and Boicho N. Kokinov eds., *The Analogical Mind: Perspectives from Cognitive Science* (Cambridge, MA: The MIT Press, 2001), 499-538.
[12] Also, Daniel Lord Smail considers metaphors to perform a lot of "our thinking for us."; Daniel Lord Smail, *On Deep History and the Brain* (Berkeley, CA: University of California Press, 2008), 78.
[13] Bruce Mazlish, "Historical Analogy: The Railroad and the Space Program and Their Impact on Society," in Bruce Mazlish ed., *The Railroad and the Space Program*, 6-9.
[14] Thomas Park Hughes, "A Technological Frontier: The Railway," in Mazlish ed., *The Railroad and the Space Program: An Exploration in Historical Analogy*, 53, 60, 71.; Leo Marx, "The Impact of the Railroad on the American Imagination, as a Possible Comparison for the Space Impact," in Mazlish ed., *The Railroad and the Space Program: An Exploration in Historical Analogy*, 211-212.
[15] Elliott West, *The Contested Plains: Indians, Goldseekers, & the Rush to Colorado* (Lawrence, KS: University Press of Kansas, 1998), xx-xxiv.

go with this vision.[16] We derive significance from the observed facts and narrate them in a manner that assists us in finding meaning in an otherwise disordered world.[17]

This dissertation will examine how this struggle between imagination, analogy, narrative, and material existence shaped science in the nineteenth and early twentieth centuries. From the data gathered about the geological history of the past, geologists and paleontologists unavoidably infused their science with the imperatives of their present concerns. They narrated the environmental past of North America in terms of its future. The narrative arc tended to be from an Edenic paradise, to a desert Fall, to redemption through America's Manifest Destiny.[18]

Materials are central to how humans construct and imagine their world and tell stories about themselves. With the rise of fossil-fueled abundance, imaginations were set free from earlier constraints. New ways of rearranging matter and reconstructing the natural world were possible. While historical actors may not have been aware of the consequences of imposing their imaginations on their environment, today we have come closer to realizing how our actions resonate through our entanglements with the nature.[19]

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[16] Elliott West, "Stories: A Narrative History of the West," *Montana: The Magazine of Western History* (1995): 64-76.

[17] William Cronon, "A Place for Stories: Nature, History, and Narrative," *The Journal of American History* 78, no. 4 (1992): 1347-1376.; Hayden White, *Metahistory: The Historical Imagination in Nineteenth-Century Europe* (Baltimore, MD: The Johns Hopkins University Press, 1973).

[18] This is similar to what David E. Nye described as "second creation"; "America conceived as a second creation built in harmony with God's first creation...They [narratives of second creation] express in secular form the beginnings of a new social world, and they establish the ideal ground rules of the society."; Nye, *America as Second Creation*, 3-4.; See also: Carolyn Merchant, *Reinventing Eden: The Fate of Nature in Western Culture* (New York: Routledge, 2004).

[19] For examples of recent studies in what has been labeled the "new materialism," see: Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, NC: Duke University Press, 2010).; Diana H. Coole and Samantha Frost, *New Materialism: Ontology, Agency, and Politics* (Durham, NC: Duke University Press, 2010).; Manuel De Landa, *A Thousand Years of Nonlinear History* (New York: Zone Books, 1997).; Caitlin DeSilvey, "Observed Decay: Telling Stories with Mutable Things," *Journal of Material Culture* 11, no. 3 (2006): 318-338.; Ian Hodder, *Entangled: An Archaeology of the Relationships*

Histories of fossils and coal have not sufficiently recognized the impact of materiality and physical context, nor have fossils and coal been fruitfully paired in historical analysis. This dissertation seeks to fill this gap and show why this pairing is essential to understanding the history of the American West. Humans physically sensing the deep past were able to dream the past into scientific reality so that it could be used by others to manipulate the earth.[20] We therefore have to consider, knowing the power of the fossil-fueled imagination, what kind of world do we want to live in.

The Subterranean Frontier

With exploration and settlement came the opening of a whole new world of ancient North America. The ghost of Frederick Jackson Turner haunts every history of the expanding western frontier. Revisions to Turner's frontier thesis abound and were pivotal to the rise of "New Western History" in the 1980s and early 1990s. Regardless of his weaknesses in terms of social, cultural, and ecological sophistication, the frontier thesis has incredible staying power.[21] Finding the roots of American identity still seems

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between Humans and Things (Malden, MA: Wiley-Blackwell, 2012).; Bruno Latour, "Can We Get Our Materialism Back, Please?" *Isis* 98, no. 1 (2007): 138-142.; Bjørnar Olsen, *In Defense of Things: Archaeology and the Ontology of Objects* (Lanham, MD: AltaMira Press, 2010).

[20] Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley, CA: University of California Press, 2002).; Linda Nash, "The Agency of Nature or the Nature of Agency?," *Environmental History* 10, no. 1 (2005): 68.

[21] For critiques of Turner's frontier thesis in New Western History, see: William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: W. W. Norton and Company, 1991).; Richard W. Etulain ed., *Essays on Major Western Historians* (Albuquerque, NM: University of New Mexico Press, 1991).; Dan Flores, "The Rocky Mountain West Fragile Space, Diverse Place," *Montana: The Magazine of Western History* 45, no. 1 (1995): 46-56.; Patricia Nelson Limerick, *The Legacy of Conquest: The Unbroken Past of the American West* (New York: Norton, 1987).; Patricia Nelson Limerick, "What on Earth is the New Western History?" *Montana: The Magazine of Western History* 40, no. 3 (Summer, 1990): 61-64.; Patricia Nelson Limerick, Clyde A. Milner II, and Charles E. Rankin eds., *Trails: Toward a New Western History* (Lawrence, KS: University Press of Kansas, 1991).; Michael P. Malone, *Historians and the American West* (Lincoln, NE: University of Nebraska Press, 1983).; Gerald D. Nash, *Creating the West: Historical Interpretations, 1890-1990* (Albuquerque, NM: University of New Mexico Press, 1991).;

like a worthwhile project. I agree with William Cronon that the history of the West, and I would argue America more generally, "has always been, the story of human beings working with changing tools to transform the resources of the land."[22] However, what has yet to be fully realized by historians is that among the bases for these changing tools were the materials generated through geologic time which were embedded in the western earth.[23] What has made America "exceptional" is diving into fossil fuel abundance and embracing its potential to transform the world to meet the nation's desires.

The deepening of geohistorical knowledge and the use of coal coincide with defining moments in American history. The independence of the American nation aligns closely with the discovery of geologic time. Meanwhile the use of coal by industrializing nations such as England was taking root as the primary energy source mobilizing the activities and imaginations of its citizens.[24] America entered into this energy revolution as coal was becoming central to an increasingly global world. Energy abundance became an integral aspect of American identity.[25] Furthermore, the incorporation of extreme temporal depth into realms beyond geology such as the work of Charles Darwin coincided with the outbreak of the Civil War. Soon after this conflict, America was set

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Well before the New Western Historians got their hands on Turner, he had already been subject to pointed criticism.; Ray Allen Billington, *The Frontier Thesis: Valid Interpretation of American History?* (New York: Holt, 1966).; Richard Hofstadter, *The Progressive Historians: Turner, Beard, Parrington* (New York: Vintage Books, 1968), 146-148.

[22] William Cronon, "Revisiting the Vanishing Frontier: The Legacy of Frederick Jackson Turner," *The Western Historical Quarterly* 18, no. 2 (Apr., 1987): 172.

[23] The western historian Patricia Nelson Limerick noted in 1992 that "scholars in the discovery of landscape," should focus on "ten elements," the first one she listed was "(1) the geologic, climactic, botanical, and zoological qualities of a particular place." (Patricia Nelson Limerick, "Disorientation and Reorientation: The American Landscape Discovered from the West," *The Journal of American History* 79, no. 3 (Dec., 1992): 1024.)

[24] E. A. Wrigley, *Energy and the English Industrial Revolution* (New York: Cambridge University Press, 2010), 36-38.

[25] Bob Johnson, *Carbon Nation: Fossil Fuels and the Making of American Culture* (Lawrence, KS: University of Kansas Press, 2014), 12.

firmly on an industrial course and quickly disregarded the humbling aspects of deep time. Mastery of an abundant and resilient natural world was an embedded fact of American life.

Left without the monuments of human antiquity that are found throughout Europe and Asia, America has long been known as nature's nation. Americans have derived their antiquity from the earth's history and have created national parks to celebrate the country's majesty.[26] As nature's nation, geoengineering (geological mastery) is at the heart of American identity. In the subterranean frontier, to borrow Turner's language, "the American intellect owes its striking characteristics."[27] This can be seen in the settling of the American West since the Louisiana Purchase and early visions of the region's potential. It became foundational after the Civil War and imaginations soared as the United States began its meteoric rise on the global stage through the exploitation of geologic history's material remains.[28] Geoengineering is often about holding onto an imagined past or present rather than creating something entirely new. Therefore, it would often be more correctly considered geo-restoration or paleo-restoration depending on the scales of time used to determine the ideal baseline.

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[26] Eric Higgs, *Nature by Design: People, Natural Process, and Ecological Restoration* (Cambridge, MA: MIT Press, 2003), 131-177.; Roderick Nash, *Wilderness and the American Mind*, 4th ed. (New Haven London: Yale Nota Bene, 2001).; Alfred Runte, *National Parks: The American Experience* (Lanham, MD: Taylor Trade Pub., 2010).; Mark David Spence, *Dispossessing the Wilderness: Indian Removal and the Making of the National Parks* (New York: Oxford University Press, 1999), 33.; Louis S. Warren, *The Hunter's Game: Poachers and Conservationists in Twentieth-Century America* (New Haven, CT: Yale University Press, 1997), 128.

[27] Frederick Jackson Turner, *The Frontier in American History* (New York: Henry Holt and Company, 1953), 37.

[28] For how this process played out internationally, see: Philipp Nicolas Lehmann, "Changing Climates: Deserts, Desiccation, and the Rise of Climate Engineering 1870-1950" (PhD diss., Harvard University, 2014).

An American subterranean frontier emerged from the geologic history of the West. The ecosystem and economy of the West extended across the nation and through time. Coal released Americans from natural checks on settlement size and simplified other resource concerns into simple problems of energy. Fossils showed the verdant landscapes teeming with life that could return. Every frontier agent, including the lonely homesteader and frontiersman with axe-in-hand, was intimately tied to this high-energy industrial system fabricated through energy abundance and visions of a greener past.[29] The parched, brittle landscape was made malleable or plastic in the minds of Americans. I use the terms malleable and plastic interchangeably to describe the variety of elements that characterized this understanding of the earth. Malleable conjures the force required to manipulate metal or other materials out of an original shape without harming the material. Plastic emphasizes the synthetic, modern, and fossil-fueled understanding of a pliable world that is moldable to human desires and is entirely a human artifact. These two defining characteristics of how the world was perceived were developed from the subterranean frontier.

Contrary to Turner's famous proclamation, this frontier process did not end in 1890. Patricia Nelson Limerick claimed that Turner was off by a century when the boom

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[29] Earl Pomeroy, "Toward a Reorientation of Western History: Continuity and Environment," *The Mississippi Valley Historical Review* 41, no. 4 (Mar., 1955): 579-600.; William G. Robbins, "Western History: A Dialectic on the Modern Condition," *The Western Historical Quarterly* 20, no. 4 (Nov., 1989): 429-449.; Cronon, "Revisiting the Vanishing Frontier," 157-176.; Cronon, *Nature's Metropolis*.; David E. Nye, *Consuming Power: A Social History of American Energies* (Cambridge, MA: MIT Press, 1998).; Martin V. Melosi, *Coping with Abundance: Energy and Environment in Industrial America* (Philadelphia, PA: Temple University Press, 1985).; For examples of historical treatment of the industrial West see: David Igler, *Industrial Cowboys: Miller & Lux and the Transformation of the Far West, 1850-1920* (Berkeley, CA: The University of California Press, 2001).; Andrew C. Isenberg, *Mining California: An Ecological History* (New York: Hill and Wang, 2005).; David A. Wolff, *Industrializing the Rockies: Growth, Competition, and Turmoil in the Coalfields of Colorado and Wyoming, 1868-1914* (Boulder, CO: The University Press of Colorado, 2003).

and bust cycles had clearly taken their toll on western peoples and environments, and economic expansion in the region had run into stark ecological limits.[30] In fact, its origins were in North America's geologic history and it continues today because the subterranean frontier is part of a larger process of fossil fuel dependence built on concentrated exhaustible photosynthetic provisions—that is, the biota of the paleo-West.[31] Boom and busts continue in places like Williston, North Dakota, where gas flares light up the night sky. Furthermore, through the subterranean frontier, the West was global when the United States was born. The coal resources of the region were going to be used in the context of interlinked industrial economies and the geology and paleontology that uncovered its geologic history would feed into an international scientific exchange of knowledge. America's position in world affairs was tied to the West's geology. As such, the subterranean frontier continues to expand with each block of coal burnt to feed America's insatiable appetite for energy.

The frontier, therefore, was redirected long before it was supposedly closed in 1890. Turner's frontier thesis is two dimensional – it has no depth. While he was writing, however, the forefront of the frontier had long been directed into the third dimension of the Earth. This was a fossil-fueled frontier that entangled the entire world in its power, anxieties, and externalities. In the context of coal-fueled industrialization, pioneering Americans were never fully set apart from a globalized carbon civilization. At the

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[30] Patricia Nelson Limerick, "Haunted by Rhyolite: Learning from the Landscape of Failure," *American Art* 6, no. 4 (Autumn, 1992): 35-36.

[31] Turner, *The Frontier in American History*, 1-38.; E. A. Wrigley, *Continuity, Chance and Change: The Character of the Industrial Revolution in England* (New York: Cambridge University Press, 1988).; Rolf Peter Sieferle, *The Subterranean Forest: Energy Systems and the Industrial Revolution* (Cambridge, MA: The White Horse Press, 2001).

national scale, Americans became tightly linked through this fuel which touched every element of their lives.

The subterranean frontier was the architect and artifact of stories told about its origins, potential, and use. Mineral energy and fossils generated the basis for powerful narratives about the West. Social power, and the ability to create and control dominant national narratives, was a form of material power. This fact did not go unnoticed by those who lived through the late nineteenth and early twentieth centuries. In 1903, Henry Adams wrote to his brother that "the whole social, political and economical problem is the resultant of the mechanical development of power."[32] Buttressed by coal-fueled industrialization, the narratives of those who controlled the most physical energy were often able to achieve the most social power.[33] This power then served to structure western society, culture, and the environment. For example, the power of scientific imagination, discourse, and authority can be understood as deriving from both the energetic and material nature of coal deposits.[34] Restoring the environment to its ancient character became an imperative for many Americans who held on to the hope that the West could be a garden. Coal granted Americans the power to literally remake the West. It was the fertile source from which modernity was born and this directional sense of time could be paired with religious purpose.

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[32] Jacob Claver Levenson, *The Mind and Art of Henry Adams* (Stanford, CA: Stanford University Press, 1968), 300.

[33] Edmund Russell, James Allison, Thomas Finger, John K. Brown, Brian Balogh, and W. Bernard Carlson, "The Nature of Power: Synthesizing the History of Technology and Environmental History," *Technology and Culture* 52, no. 2 (Apr., 2011): 246-259.; Vaclav Smil, *Energy in Nature and Society: General Energetics of Complex Systems* (Cambridge, MA: The MIT Press, 2008).; Richard White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill and Wang, 1995).

[34] Steven Johnson, *The Invention of Air: A Story of Science, Faith, Revolution, and the Birth of America* (New York: Riverhead Books, 2009), 126.

Even the founder of the frontier thesis often used geological metaphors in his narrative of American progress, stating, "civilization in America has followed the arteries made by geology" and that the frontier moves like "successive terminal moraines."[35] The subterranean frontier, to use Turner's language, was "a gate of escape from the bondage of the past."[36] The transition from wood to coal, some scholars contend, can be thought of as a revolutionary shift from an organic economy to a mineral economy.[37] Coal prevented the need to adapt to the western environment. Many Americans believed that with the use of the massive amount of energy available through fossil fuels, they could purposefully supersede and alter the natural world and entertain what historian Christopher Jones has called "the possibility of continual growth."[38] What was found in the region was adapted to preexisting national mythologies and sustained the belief in America's exceptional abundance and power. Yet, it also linked Americans to the history of the earth and to global ecologies. There has been a general lack of historical work concerning the cultural and social impacts of coal consumption and its attendant faith in human mastery over the environment.[39] This dissertation provides an example of this process in the settlement of the American West.

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[35] Turner, *The Frontier in American History*, 4, 10, 11, 14-15.; His interest in geology can be traced to his education and teacher Charles Van Hise: William Coleman, "Science and Symbol in the Turner Frontier Hypothesis," *The American Historical Review* 72, no. 1 (Oct., 1966): 28.
[36] Turner, *The Frontier in American History*, 38.
[37] A prime example of this is in the work of E. A. Wrigley.: Wrigley, *Continuity, Chance and Change.*; Wrigley, *Energy and the English Industrial Revolution*.; See also: Lewis Mumford, *Technics and Civilization* (Chicago, IL: University of Chicago Press, 2010), 157.
[38] Christopher Jones, "A Landscape of Energy Abundance: Anthracite Coal Canals and the Roots of American Fossil Fuel Dependence, 1820–1860," *Environmental History* 15, no. 3 (2010): 453.
[39] Some noted exceptions that contain elements of the cultural and social impacts of coal consumption are: Thomas G. Andrews, *Killing for Coal: America's Deadliest Labor War* (Cambridge, MA: Harvard University Press, 2008).; Barbara Freese, *Coal: A Human History* (Cambridge, MA: Perseus Publishing, 2003).; Johnson, *Carbon Nation*.; Christopher F. Jones, *Routes of Power: Energy and Modern America* (Boston, MA: Harvard University Press, 2014).; Melosi, *Coping with Abundance*.; Timothy Mitchell,

Coal energy production and consumption undergirded the surge in industry, population, and changing geography that characterized the U. S. West in the late 1800s through the early 1900s. The histories of energy consumption that exist are focused on the U. S. East or on Britain's industrialization.[40] Regional coal histories of the West all share a general story centered on capitalists, miners, strikes, and coal production. They perpetuate the legendary violence of the region and frequently ignore the consumption of coal as a national energy resource, and the roles played by scientists and explorers in coal development.[41] Furthermore, virtually none of the histories of coal consider its material nature as former vegetative matter.[42] Beyond its energetic qualities, this is a crucial element of how coal was consumed as a cultural product.

A fruitful avenue for considering coal's historical impact is through its origins. To this end, geological history has begun to insinuate itself into historical analysis. Energy is the core natural resource of the modern world. The majority of our energy is the product of stored solar energy embedded in the earth. Using this energy, humans reached into

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Carbon Democracy: Political Power in the Age of Oil (New York: Verso, 2011).; Nye, *Consuming Power*.; Smil, *Energy in Nature and Society*.

[40] For example, historians of energy production and consumption Vaclav Smil, Alfred Crosby, Martin Melosi, Barbara Freese, and David Nye have principally narrated the history of coal through the lens of industrializing Britain and the U.S. East.: Alfred W. Crosby, *Children of the Sun: A History of Humanity's Unappeasable Appetite for Energy* (New York: W. W. Norton & Company, 2006).; Freese, *Coal*.; Melosi, *Coping with Abundance*.; Nye, *Consuming Power*.; Vaclav Smil, *General Energetics: Energy in the Biosphere and Civilization* (New York: John Wiley & Sons, 1991).; Vaclav Smil, *Energy in World History* (Boulder, CO: Westview Press, 1994).

[41] For example: A. Dudley Gardner and Verla A. Flores, *Forgotten Frontier: A History of Wyoming Coal Mining* (Boulder, CO: Westview Press, 1989).; Isenberg, *Mining California*.; Priscilla Long, *Where the Sun Never Shines: A History of America's Bloody Coal Industry (*New York: Paragon House, 1989).; Martin V. Melosi and Joseph A. Pratt ed. *Energy Metropolis: An Environmental History of Houston and the Gulf Coast* (Pittsburgh, PA: University of Pittsburgh Press, 2007).; Wolff, *Industrializing the Rockies*.; William Wyckoff, *Creating Colorado: The Making of a Western American Landscape 1860-1940* (New Haven, CT: Yale University Press, 1999).: For a brief discussion of the overemphasis of past Western violence, see: Limerick, *The Legacy of Conquest*, 173-175.

[42] One noted example is the work of Rolf Peter Sieferle who analyzed the impact of coal on freeing land previously required for timber growth for fuel in Europe. (Sieferle, *The Subterranean Forest.*)

ancient ecosystems.[43] In the case of the American West, the ecosystem extended into the Cretaceous and Tertiary Periods.

Exploiting the subterranean frontier released the genie of geologic time by rewilding carbon trapped in the earth. This process converted coal into energy and atmospheric pollutants. Resources that took millions of years to create may be exhausted in a matter of hundreds of years. In the process, human time and geologic time have been forever changed. The first of the post-colonial scholar Dipesh Chakrabarty's four theses—that "Anthropogenic Explanations of Climate Change Spell the Collapse of the Age-old Humanist Distinction between Natural and Human History"—elaborates this point and encourages historians to take on a wider perspective in the context of climate change.[44] Today, some advocates of the proposed Anthropocene argue that as soon as humans began to extract and utilize fossils fuels, they entered into a new human-centered geological epoch, an era that instead of distancing humans from the natural world, actually enmeshes us more deeply into its cycles.[45]

However, in the late nineteenth century, coal discouraged this view at the same time that it was being conceived of as a possibility. The discovery of deep time and that humanity was a small part of the long narrative of natural history and enmeshed in the earth's processes, could have inspired humility and the breakdown that Chakrabarty suggests over a century earlier. Instead, the abundant stores of energy formed through those very long expanses of time encouraged the opposite reaction. In other words, the

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[43] Sieferle, *The Subterranean Forest*, 119, 203.
[44] Dipesh Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry* Winter (2009): 197-222.
[45] Will Steffen, Paul J. Crutzen, and J. R. McNeill, "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?" *Ambio* 36, no. 8 (December 2007): 614-621.

collapse occurred in the late-nineteenth and early-twentieth centuries when Americans saw themselves as geologic agents, but was summarily rejected in the face of the very fossil fuels that now have encouraged Chakrabarty to think about collapsing these distinctions. With their imaginations powered by coal, humans could have faith that they were not a part of the system; they were the culmination of it, destined to be the masters of the Earth. When the bottom of time dropped out from under Americans they held firmly to sacred chronologies.[46] It is only today, with the anxieties of modernity in full swing and science forecasting assured climatic catastrophes, that abolishing the distinction between human and natural history has meaning beyond mastery. The question that motivates Chakrabarty and many advocates of the Anthropocene is if humans were ever really in control.

It took industrialization to set conditions for scientists to see and comprehend geologic time. Coal-fueled industrialization yielded anxieties from the unpredictable and insatiable nature of the society it built, as well as a powerful faith in technology and science to master the world. Out of this context we get two very different though complimentary visions of the human relationship to the natural world. Preservation and geoengineering. Both are anthropocentric, and both are built on the idea of humanity's ability to control their environment. Where they primarily diverge is that one imposes limits on consumption, while the other encourages its growth.

American's interpretation of the planetary histories of Mars and Venus serve as an example of this bifurcation. Mars, the god of war, has represented large-scale geoengineering from illustrating the need for State-level irrigation works in the early

[46] Daniel Lord Smail, *On Deep History and the Brain* (Berkeley, CA: University of California Press, 2008).

twentieth century to the example of terraforming that began this introduction. Mars' geologic history can be used to tell a story of mastery. Venus, the goddess of love, has inspired NASA's climate scientist James Hansen to reconsider the fossil-fueled mastery that inspires the rhetoric surrounding Mars. Venus' history shows the "runaway" climatological effects of a carbon-saturated atmosphere. In what Hansen calls the "Venus Syndrome," humanity has lost control and our grandchildren will bear the consequences. While he does not rule out the likelihood of geoengineering, he has encouraged a path of sustainability through the use of renewable energy sources and a severe reduction in the burning of fossil fuels.[47] Embedded in the Anthropocene are these two visions of the future derived from planetary pasts.

Getting Back to Environmental History's Roots through the Deep Past

Like many nineteenth-century Americans and today's NASA climatologists, I argue that there is historical significance to be found in the geologic history of the earth. The field of environmental history has its roots in the agency of nature advanced by the *Annales* School and the environments of the American West. Geological history was an analytical tool for historians of the French *Annales* School who argued for the *longue duree* in which the material environment played a more active role in human history. When similar ideas reemerged with the advent of environmental history, many took pains to avoid the taint of determinism that might emerge from taking the agency of the environment seriously. Yet, to travel too far down the competing social constructivist

[47] James Hansen, *Storms of my Grandchildren: The Truth About the Coming Climate Catastrophe and Our Last Chance to Save Humanity* (New York: Bloomsbury, 2009).

path was, in the eyes of many environmental historians, to destroy the soul of environmental history: the historical agency of an independent material world. Without an objective, accessible material reality, nature and environments could not have sufficient agency to be historically relevant. Prominent western historians such as William Cronon and Donald Worster explored this tension in their debates.[48]

More recently, environmental history has found an innovative approach to these issues by turning to a new environmental stage, one that attempts to connect the geological past to the present.[49] The geological concept of deep time, or its historical analogue in deep history, has become an increasingly useful analytical tool.[50] Thinking historically about paleo-environments is an example of utilizing a new scale of time in considering the *longue duree*—perhaps what we might somewhat tongue in cheek term the *trés longue durée*. The *longue duree* of the *Annales* school helps to envision the frontier geohistorical landscape that encouraged Americans to understand the

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[48] See: William Cronon, "The Trouble with Wilderness: Or, Getting Back to the Wrong Nature," *Environmental History* 1, no. 1 (Jan., 1996): 7-28.; And comments in the same issue on pages 29-55.; William Cronon, "The Uses of Environmental History," *Environmental History Review* 17, no. 3 (Autumn, 1993): 7.; William Cronon, "Modes of Prophecy and Production: Placing Nature in History," *The Journal of American History* 76, no. 4 (Mar., 1990): 1124.; Donald Worster, "Transformations of the Earth: Toward an Agroecological Perspective in History," *The Journal of American History* 76, no. 4 (Mar., 1990): 1089.; Donald Worster, "Seeing beyond Culture," *The Journal of American History* 76, no. 4 (Mar., 1990): 1142.

[49] See, for example: Andrews, *Killing for Coal.*; Matthew Klingle, *Emerald City*: *An Environmental History of Seattle* (New Haven, CT: Yale University Press, 2007).; Neil M. Maher, *Nature's New Deal: The Civilian Conservation Corps and the Roots of the American Environmental Movement* (New York: Oxford University Press, 2008).

[50] Paul Howard Carlson, *Deep Time and the Texas High Plains: History and Geology* (Lubbock, TX: Texas Tech University Press, 2005).; Diana K. Davis, *Resurrecting the Granary of Rome: Environmental History and French Colonial Expansion in North Africa* (Athens, OH: Ohio University Press, 2007).; Neil Roberts, *The Holocene: An Environmental History* (New York: B. Blackwell, 1989).; Andrew Shryock, Daniel Lord Smail, and Timothy K. Earle, *Deep History: The Architecture of Past and Present* (Berkeley, CA: University of California Press, 2011).; William J. Turkel, *The Archive of Place: Unearthing the Pasts of the Chilcotin Plateau* (Vancouver: UBC Press, 2007).; Donald Worster, "A Long Cold View of History: How Ice, Worms, and Dirt Made Us What We Are Today" *The American Scholar* 74, no. 2 (2005): 57-66.

environment as malleable.[51] The preeminent *Annales* scholar, Marc Bloch, stated that "[t]he variety of historical evidence is nearly infinite" and that "geology is, in its way, a historical discipline."[52] Bloch expanded this in stating, "real time is, in essence, a continuum. It is also perpetual change," and "the mighty convulsions of that vast, continuing development are perfectly capable of extending from the beginning of time to the present."[53] For Bloch, there were no temporal limits to the scope and view of the historian. Historians should mine the deepest depths of time.[54]

In this dissertation I will argue that using longer time scales can enable historians to see the material agency of environments and objects in a more holistic manner, one that ties the deep past to the events of recent history through the enduring agency of the ancient things that have survived to become actors millions of years after their creation: coal and fossils.[55] Likewise, the agency of the deep past confirms the contemporary

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[51] For more information on the *Annales* School, see: Fernand Braudel, *Civilization and Capitalism 15th-18th Century, Volume 1: The Structures of Everyday Life: The Limits of the Possible*, trans. Sian Reynolds. (New York: Harper & Row, Publishers, 1979).; Peter Burke, *The French Historical Revolution: The Annales School, 1929*-89 (Stanford, CA: Stanford University Press, 1990).; Michael Harsgor, "Total History: The Annales School," Journal of Contemporary History 13, no. 1 (Jan., 1978): 1-13.; Lynn Hunt, "French History in the Last Twenty Years: The Rise and Fall of the Annales Paradigm," *Journal of Contemporary History* 21, no. 2, Twentieth Anniversary Issue (Apr., 1986): 209-224.; Emmanuel Le Roy Ladurie, *The Peasants of Languedoc*, trans. John Day (Chicago, IL: University of Illinois Press, 1974) ix-8.; See also Ladurie's chapter titled "History Without People: The Climate as a New Province of Research" in Emmanuel Le Roy Ladurie, *The Territory of the Historian*, trans. Ben and Sian Reynolds (Chicago, IL: University of Chicago Press, 1979), 287-316.

[52] Marc Bloch, *The Historians Craft*, trans. Peter Putnam (New York:Alfred A. Knopf, Inc., 1953), 66, 28.

[53] Bloch, *The Historians Craft*, 28,41.

[54] Recently, two scholars advocated for a return to the *Annales* School's *longue duree*.: Jo Guldi and David Armitage, *The History Manifesto* (United Kingdom: Cambridge University Press, 2014).

[55] Some, such as the environmental historian Peter C. Perdue, question the practical utility of deep time for analyzing the recent past. But even Perdue admits that global climate change has the potential to unite Braudel's three levels of time at the scale millennia-long biogeochemical cycles. Also, as historians Nancy Langston and Edmund Russell argue, unconventionally long time scales can be constructive through frameworks such as Russell's "evolutionary history.": Richard C. Hoffmann, Nancy Langston, James C. McCann, Peter C. Perdue, and Lise Sedrez, "AHR Conversation: Environmental Historians and Environmental Crisis," *American Historical Review* 113, Issue 5 (December 2008): 1438-1439, 1443.;

realization that the separation between human history and the vast forces of a geological natural history is not so wide as many have long assumed. Western environmental historians need return to their roots in the earth.[56]

This dissertation argues that the American West should not only be known for its present aridity. It should also be viewed through its watery paleo-environmental past, which informed subsequent human interaction in the region. It reveals the web-like interconnection of material and cultural developments that situate humans as elements in the planetary historical narrative. This approach implicates humanity in the narrative of deep time and reintegrates the species into the history of the natural world and earthly ecology. Using the *longue duree* to re-conceptualize the West through its geologic history disrupts the idea that the primary frame of historical analysis should be centered on the existence of the human species.[57] This method serves to reveal how science and technology collapsed conventional distinctions of time, making ancient environments "real" in a way previously impossible. The geologic past and technological systems do not determine history, rather they are merely prominent threads woven through space and time. They serve as the sites of contact for the needlepoint of narrative to texture the canvas of the past. The material and social effects of using the products and narratives of geologic history have had profound consequences for western settlement, dispossession, industrial technologies, and the sciences of geology and paleontology.

Edmund Russell, "Evolutionary History: Prospectus for a New Field," *Environmental History* 8, no. 2 (Apr., 2003): 204-228.

[56] Hal K. Rothman, "Environmental History in the American West," *OAH Magazine of History* 9, no. 1 (Fall, 1994): 28-32.

[57] Marc Bloch, *The Historians Craft*, 28, 66.; Fernand Braudel, *On History*, trans. Sarah Matthews (Chicago, IL: The University of Chicago Press, 1980), 29-30.

The tendency for environmental histories of the West has been a narrative of either adaptation or failure in the face of the unceasing aridity of the region west of the 100th meridian.[58] Yet, we are in the midst of a dynamic climatological experiment as a result of energetic resistance to environmental limits in places like the West. Aridity may be a fact of life in this region, but its geologic history made that fact disposable in the eyes of many Americans. If aridity truly defined the West, the advice of men like John Wesley Powell would have been heeded. Something else must have been at work. Aridity may have been the environmental factor that western settlers had to contend with as they were entering into what was once known as the "Great American Desert." However, it was the verdant and lively deep past of the North American continent that helped to overcome that environmental obstacle and push people West after the Civil War. Settlers probably should not have settled land where they did and try to make it agriculturally prosperous. They did so as a result of the region's promise of plasticity.

It was not simply the "free land" of the frontier that defined America, but what was beneath it.[59] Turner compared the work of the historian to that of the geologist who "traces patiently the shores of ancient seas, maps their areas, and compares the older and the newer."[60] The landscape is more than a backdrop; it is a living and historied space occupied by the vestiges and residue of those who inhabited it. Time, the fourth dimension, must also be reconciled with our histories of the American West. Time and

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[58] This will be discussed in more detail in Chapter 7 and 8, but classics in this vein include: James Claude Malin, *The Grassland of North America, Prolegomena to Its History* (Lawrence, KS: James C. Malin and Edwards Brothers, 1947.; Walter Prescott Webb, *The Great Plains* (Boston, MA: Ginn, 1959).; Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West* (New York: Pantheon Books, 1987).
[59] Turner, *The Frontier in American History*, 1, 37.
[60] Turner, *The Frontier in American History*, 10.

space are equally affected by the nature of vastness. Both require that we have to fill in perceptual gaps because it is impossible to grasp that vastness with the limits of our faculties. [61] The space of the frontier was expanding in time with the use of materials found embedded in the Earth. The meaning of this movement and these materials were inevitably set within cultural expectations and hopes for the future of America. Western historians must therefore understand the deep history of the North American continent in order to understand its human history.

The deep histories of western American landscapes that created fossils and fossil fuels captured imaginations since at least the early-nineteenth century, a period of increasing acceptance of the incredible depths of time required for geologic processes. While the essence of the concept originated with Scottish geologist James Hutton and had been in circulation since the eighteenth century, author John McPhee coined the term "deep time" in 1981 to describe the confounding nature of extreme temporal expanses.[62] The human mind struggles to grasp deep time, and in the process, cultural imperatives seep into our visions of the deep past. Contemplating deep time (or geologic time), according to McPhee, can foster "a kind of companionship with the earth."[63]

Instead of the blissful companionship suggested by McPhee, nineteenth-century Americans treated the Earth as if it were a slave to be broken. For many, humans were the culmination of divine creation and coal was given to us as a godly gift that would secure our mastery over creation. In this context, cultural attitudes encouraged

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[61] Yi-Fu Tuan, *Space and Place: The Perspective of Experience* (Minneapolis, MN: University of Minnesota Press, 1977), 16.; W. James, *The Principles of Psychology* Vol. 2 (New York: Henry Holt and Company, 1918), 203.
[62] John McPhee, *Basin and Range* (New York: Farrar, Straus, Giroux, 1981), 21.
[63] McPhee, *Basin and Range*, 129.

interpreting the geological record as a path of earthly progress. In western societies, time is often seen as progressive.[64] The powerful hold of the progress narrative, for example, was naturalized in the paleontological record.[65] A former Edenic landscape could be found through the science of paleontology, encouraging the continuance of this progress narrative. Fossils were also yielding evidence of the plasticity of the environment that could be restored using new technologies.[66] The construction of a more complete understanding of ancient western environments occurred in tandem with the rush of frontier settlement that characterized the late-nineteenth century. The providential messages of Manifest Destiny mingled with fossil finds to create a scientifically informed vision of the nation's fortuitous future. Looking into the deep past, some scientists, settlers, and boosters became what I call *paleo-restorative dreamers*, who optimistically believed that past environments could return in the future.

In looking at climate and the role of materials such as coal and fossils, the use of contemporary science is often an important tool for granting agency to the natural world. The environmental historian Paul Sutter has offered a useful guide to the contemporary use of science, as he recognizes the importance of historicizing science, yet he also notes that material things can gain real historical agency when humans grapple with them through their socio-cultural ideas.[67] Sutter offers a means to join the social-constructivist and materialist analysis of the natural world, revealing the roles of human and

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[64] Stephen Jay Gould, *Time's Arrow, Time's Cycle: Myth and Metaphor in the Discovery of Geological Time* (Cambridge, MA: Harvard University Press, 1987), 12.; Yi-Fu Tuan, *Topophilia: A Study of Environmental Perception, Attitudes, and Values* (New York: Columbia University Press, 1990), 148-49.
[65] Gould, *Time's Arrow, Time's Cycle*, 137.
[66] Merchant, *Reinventing Eden*.; Noble, *The Religion of Technology*.; Nye, *America as Second Creation.*
[67] Paul S. Sutter, "Nature's Agents or Agents of Empire? Entomological Workers and Environmental Change during the Construction of the Panama Canal," *Isis*, 98 (2007), 729.

environmental agents in interacting with and reconstructing environments through knowledge and ideas. In a similar way, this dissertation suggests that material things like coal and fossils gain agency as scientists and others grapple with their meanings using their own cultural tools. Contemporary scientific descriptions of ancient western environments and the production of fossils and fossil fuels follow and should be understood and as analytical tools for understanding the agency of nature.

The Watery Geologic History of the American West

The geologic events, environments, and flourishing life of the Cretaceous and Tertiary Periods are central agents in this history [Figure 2]. As will be covered in Chapter 4, the nature of fossilization has yielded conditions ripe for imagining landscapes as seascapes. One of the so-called "biases" in the fossil record is that flora and fauna of the marine variety are far more likely to be preserved. This bias can plainly be seen in the American West in regions that were covered with water long ago. Nineteenth-century survey scientists regularly encountered these objects and considered their origins. The geological events that accompanied the transition from the Cretaceous to the Tertiary Period (what scientists today refer to as the K/T boundary) had long intrigued explorers and scientists who sought to find relics of these past times to prove their theories. For example, this led Ferdinand Vandeveer Hayden to seek out the extent of what he called the "Great Lignite" (later named the Laramie Formation by Clarence King) formed during this transition. In the process of defining the extent of this region and determining its characteristics he found fossilized flora and fauna that spoke of the changes that took place in the history of the West.

Geologists tell us that the Cretaceous was a wild time for North America. It lasted from about 145 million years ago to about 65 million years ago.[68] That last date may be familiar since it traditionally marks the extinction of dinosaurs. During these millions of years, tectonic forces elevated the Rocky Mountains and much of the western plains. As the majestic Rockies rose and increased in mass, a depression temporarily formed adjacent to their base. The majority of the movement that made these iconic mountains occurred at the tail end of the Cretaceous, from about 70 to 90 million years ago.[69] The depression at the base of the Rockies filled with shifting levels of water that fluctuated in width according to tectonic movement. This body of water is now known as the Western Cretaceous Interior Seaway (WCIS).[70] At times, it covered the area now known as Montana, Wyoming, the Dakotas, Colorado, Oklahoma, Nebraska, Kansas, New Mexico, Texas, and parts of Missouri, Iowa, Minnesota, central Canada, and Mexico.[71] Melted ice caps, peak sea levels, and volcanic outgassing of CO_2 submerged low-lying areas of North America under a shallow sea no deeper than 600 feet.[72] According to Walter E. Dean and Michael A. Arthur, the sources "of this warm climate are not well understood, but are presumed to be related to a major 'greenhouse' phenomenon, which possibly was

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[68] Ron Blakey and Wayne Ranney, *Ancient Landscapes of the Colorado Plateau* (Grand Canyon, AZ: Grand Canyon Association, 2008), 87-101.
[69] David Alt and Donald W. Hyndman, *Roadside Geology of Montana* (Missoula, MT: Mountain Press Publishing Company, 2009), 10-11.
[70] This dissertation will also use the term "Cretaceous Seaway."
[71] Michael J. Everhart, *Oceans of Kansas: A Natural History of the Western Interior Seaway* (Indianapolis IN: Indiana University Press, 2005), 5.
[72] Everhart, *Oceans of Kansas*, 6-7, 240. ;Walter E. Dean and Michael A. Arthur, "Cretaceous Western Interior Seaway Drilling Project: An Overview," in *Stratigraphy and Paleoenvironments of the Cretaceous Western Interior Seaway, USA*, ed. Walter E. Dean and Michael A. Arthur (Tulsa OK: Society for Sedimentary Geology, 1998), 2.

the result of increased volcanic outgassing of carbon dioxide."[73] After the tectonic processes had eased at the boundary between the Cretaceous Period and the subsequent Tertiary Period (65 to 2 million years ago), the seaway retreated back to the depths of the ocean basins [Figures 3 and 4]. In the wake of its recession, organic remains that would later become deposits of fossils and fossil fuels remain suspended in their stratified graves. As the seaway escaped into the ocean, the land remained dotted with Tertiary lakes and continued to support an abundance of life. In western Cretaceous and Tertiary strata, the close proximity of fossils and fossil fuels was plainly evident to the eyes and minds of scientists surveying the landscape throughout the nineteenth century. Material remains of the watery West were also seen and interpreted by Native Americans, explorers, and western settlers [Figure 5].

The Cretaceous period was full of life. According to Michael Everhart, the WCIS was home to "giant clams, rudists, crinoids, squid, ammonites, numerous sharks and bony fish, turtles, plesiosaurs, mosasaurs, pteranodons, and even several species of primitive marine birds with teeth."[74] We know of these creatures through their fossilized remains. Three primary processes convey ancient life into the present. The first is permineralization or petrification where minerals in solution join with bone by way of water infiltrating the plant or animal. The second is replacement whereby bone and hard tissues are dissolved by water and replaced entirely by minerals. The final manner in which fossilization occurs is through molds and casts of an organism's shape that are

[73] Dean and Arthur, "Cretaceous Western Interior Seaway Drilling Project: An Overview," 2.
[74] Everhart, *Oceans of Kansas*, 7.

created from surrounding geological materials while the original plant or animal becomes lost to the ravages of time and decay.[75]

During much of the Cretaceous and Tertiary Periods, the land also was covered with a luxuriant verdure that is responsible for providing the raw materials for much of today's western coal reserves. The coal is technically from the Paleocene Epoch, at the border of the Cretaceous and Tertiary Periods.[76] Much of the coal in Montana was formed as a result of the shifting dimensions of the WCIS that formed isolated bogs and swamps across the landscape.[77] These heavily vegetated, isolated bodies of water resulted in the formation of large coal beds soon after (geologically speaking) the Cretaceous period ended. Nevertheless, popular and academic representations of these coal regions have tended to describe them as Cretaceous.[78] How contemporaries in the nineteenth century understood coal formation will be discussed in Chapters 2 and 3.

The science of coal formation in brief is as follows [Figure 6]. Peat serves as the point-source for the creation of coal. Peat is essentially a jumble of dead and decaying

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[75] "How are Fossils Formed," New York State Museum, New York State Geological Survey, accessed August 7, 2014. http://www.nysm.nysed.gov/nysgs/resources/fossils/form.html.

[76] The Tertiary Period is now known as the Paleogene Period. I have retained the use of Tertiary since the historical actors in this dissertation use this terminology. It is also important to note that coal and fossil formation are not necessarily the products of singular environments. They are formed over vast expanses of time and are the result of changing environments and geological conditions that affect them up until they are extracted from the Earth.

[77] Coal from a number of ages and former environments dot the West. Cretaceous and Tertiary coals are some of the most abundant in the West and some of the most documented in the historical record.

[78] Albert W. Bally and the Geological Society of America. *The Geology of North America: An Overview. A,[1]* (Boulder, CO., 1989), 555-573; Albert W. Bally and the Geological Society of America. *The Geology of North America: Economic Geology, U.S. P,[2]* (Boulder, CO., 1989), 463-522, 547-590; Albert W. Bally and the Geological Society of America. *The Geology of North America: Sedimentary Cover – North American Craton: U.S. D,[2]* (Boulder, CO., 1989), 77-82, 221-241.; Dean and Arthur, "Cretaceous Western Interior Seaway Drilling Project: An Overview," 2.

plant matter ensnared in an anoxic environment.[79] Coal is formed from peat through a process termed "coalification," which consists of the forces of time, decay, pressure, and heat. Before these processes can take their toll, the peat must be covered by sediment.[80] Coal comes in four degrees of quality. The first is lignite, the greatest quantity of coal across the earth. It is the lowest quality and most resembles its floral antecedents. You can clearly see that it was once plant matter. The next level is subbituminous, followed by bituminous. The majority of the coal found in the West is lignite or subbituminous. The purest coal is anthracite which is typically found in Pennsylvania. Each level of coal quality comes with associated increases in concentrated potential heat energy.[81]

Chapter Summary

The dissertation is structured into three basic sections. The first is centered on coal, the second concerns fossils, and the third pertains to western settlement. The idea behind the structure is for each chapter to build off of the next so that the final chapters illustrate the ways in which the material remains of geologic history (coal and fossils) played a previously unrecognized but fundamental role settling the American West.

Chapter one, "The Red Sea to the Desert West: The Imagined and Physical West of the Early Nineteenth Century," illustrates how the American West has long been a mental landscape subject to the hopes and dreams of its interpreters. As Europeans and Americans imagined the western frontier, their worldview crept in and painted the region

[79] "What is peat?" International Peat Society, accessed March 16, 2015. http://www.peatsociety.org/peatlands-and-peat/what-peat.
[80] "How is Coal Formed?" Kentucky Geological Survey, University of Kentucky, accessed March 16, 2015. http://www.uky.edu/KGS/coal/coalform.htm.
[81] "Coal, our most abundant fuel," U. S. Department of Energy, accessed March 16, 2015. http://www.fe.doe.gov/education/energylessons/coal/gen_coal.html.

with descriptions ranging from an Edenic garden to a barren desert. The chapter begins with cartographic visions of California as an island that brought hope that the trek across the continent would not be arduous. Using maps of California as an island, it considers the constructedness of cartographic representation. Also, it shows that these maps also set up a mental space for seeing a sea in the western portion of the continent. The chapter then turns to Thomas Jefferson's desires for the future of the West and the explorations of Lewis and Clark. The explorations of this pair spoke overwhelmingly of a fertile landscape that could be traversed successfully. However, their vision of a fertile West was subsequently undermined by the travels of Zebulon Pike and Stephen Harriman Long who saw the West as a desert barrier. The idea of a "Great American Desert" then made its way into the American public's imagination and onto maps used by school children. This dreary image of the frontier became the focus of booster literature that directly refuted it with garden visions. In the decades before the Civil War, the region proved itself to be plastic in the imagination, and after the War, science would help many to imagine a plastic West.

Chapter two, "The Power of the Geologic Past: Making Deep Time Relevant to 19th Century America," examines geological treatises, textbooks, and mining manuals in order to assess the rise of geology as a science in America, the initial impact of signs of a changing world embedded in coal, the religiosity of coal, and deep time's irrelevance in a high-energy society fueled by coal. The chapter begins with deep time's cyclical qualities and the rise of geological history as revealed in the work of James Hutton and Charles Lyell. It then turns to the divine qualities of coal in industrial societies. Coal was central

to the ways in which many scriptural and deistic geologists understood the beneficent will of God revealed in the geological record. Because of its contributions to revolutionizing modern life, coal was seen as gift and the fuel of civilization. Coal was a useful tool and played a significant role in the rise of American geology. It also opened up windows into the ancient earth where the tropical flora of times past could be viewed and touched by scientists and miners alike. The history of the earth was revealed in these coal seams. The next section describes two elements of geological practice that form the basis for seeing the past through fossil remains. Geologists have regularly used historical analogy and vivid imaginative journeys in order to know the ancient environments that they investigate. Lastly, the chapter addresses how nineteenth-century scientists recognized the human capacity to alter the earth using coal. Geological processes were condensed when this geological fuel was released and rewilded.

Chapter three, "Coal and the Transcontinental Railroads: Tools for Reimagining and Recreating the Ancient West," functions as a case study in the use of coal by the nineteenth century's most powerful technological system – the transcontinental railroads. It demonstrates the crucial role that coal played in the settling of the American West and how science, settlement, the transcontinental railroads, and resource extraction histories can be united to tell a more complete history of the frontier. This chapter will illustrate the coal-fueled power of the transcontinental railroad technological systems that spanned the West. It will also show that the transcontinental railroads and America's coal-fueled industrial society grew up together in the mid-to-late nineteenth century. Specifically, it will evaluate the exploitation of coal by the Union Pacific Railroad and the Great

Northern Railway for the dual purpose of fueling their locomotives and settling sections of the West. Lastly, it will cover the rise of the United States Geological Survey of the Territories and the reciprocal relationship between scientists and the railroads in exploring the West for coal and the fossils accompanying it in the earth. It will evaluate the crucial nature of coal for the settling of the American West and the fact that coal's fossil character helped to construct geo-historical visions of the West as a formerly lush and watery region that stood in stark relief to its arid character.

Chapter four, "Science, Nationalism, Religion, and a Watery Vision for the West: Seeing the Changing Future of America's Environment through its Past," begins my discussion of the role of fossils in how Americans saw their past and future. The visions of a changing world fostered by fossil finds embedded in coal were complemented by paleontological explorations in the West that revealed a more complete image of the past. The chapter starts with how western fossils informed nationalism, environmental perceptions, and religion in Antebellum America. Next, it turns to the United States Geological Surveys of the Territories under Ferdinand Vandeveer Hayden and centrality of the K/T boundary in these reports. The earth's history was detailed to an audience interested in exploiting the resources of the West. The imaginations of these men gave this former world life and painted scenes of the past with vibrant color. As revealed by authoritative scientists, the frontier's deep history showed its changing character. The finding and interpreting of fossils was also the province of fossil hunter field workers who ventured out to seek the past in the dirt. This profession brought another group of individuals into close contact with the geological history of the West. Some of these men

would attempt to reconcile their biblical beliefs with the fossils they found. Since they were encountering these fossils in context, the fossil hunter field workers also often juxtaposed the watery past with the arid environment that they experienced with their bodies. Those who touched and pondered fossils had to square them with their worldview. As the region was opening up with the help of the railroads, more Americans came in contact with these relics and had to find ways of creating meaning from these materials.

Chapter five, "Other Americans Experience the Plastic West through Fossils: Native Americans, Westerners, and Vernacular Paleontology," demonstrates the wide interest in western fossils that exposed a large population of Americans to the geological history of North America. This chapter begins with how Native Americans incorporated fossils into their cosmology seeing them as evidence of a changing world and as powerful natural resources to be held as sacred. American scientists recognized the fact that these native westerners were familiar with fossils and sought to take advantage of their knowledge for the purpose of advancing western science. While the scientist's worldview was different from their Native guides, both saw in the fossils the past and the future environmental changes of the West and their power as natural resources. The chapter then turns to other westerners who made their way into this region and while making the place their home many happened upon fossils that they collected and shared with scientists. It ends with a discussion of an exceptional westerner by the name of James Cook whose life encompassed the rapidly changing West, its clash of cultures, and interest in its fossil past.

Chapter six, “Finding Profit in the Public’s Fascination with Fossils: The Media, Peddling Curios, Railroads, and Boosting the West through its Geologic History,” traces the extent to which interest in the remains of geologic history spread in the nineteenth century and how this interest was put to use for varied purposes. The public worked to make sense of fossil remains found in the West and enterprising individuals took advantage of interest in these curious relics and fed fossils into a national market. The railroad is once again a character in this story as a partner in spreading fossil knowledge, in providing inadvertent access to fossil finds and geologic knowledge, and in adapting western geology to advertising ends. The Green River railroad cut is also a thread that connects the sections. This chapter provides a window into how different segments of society valued and understood fossils. Lastly it demonstrates how boosters began to use the West’s geologic history to bolster its future as America’s promised land.

Chapter seven, “The Revival of the Garden West and its Opponents: North America’s Geologic History Supports a Progressively Changing West,” looks through the works of Ferdinand Vandeveer Hayden, Richard Smith Elliott, Cyrus Thomas, Samuel Aughey, Charles Dana Wilber, William Babcock Hazen, Grove Karl Gilbert, and John Wesley Powell to demonstrate the geological character of western climate change theories such as rain follows the plow and how opposition to these visions were difficult to demolish due to their basis in the earth sciences. This will show how these theories were backed by the same USGS survey science that was being performed to take advantage of the natural wealth of the West. It will thereby illustrate how western settlement was affected by the North American continent’s geologic history. The geology

of the West was used to support its changing character. Those who did not muster it were convinced of its static barrenness. Others who called upon it could not reject the possibility of a progressively changing climate. Some did this enthusiastically, while others were more conservative. Nevertheless the geology of the West provided scientific encouragement to theories of progressive climactic change such as rain follows the plow.

Chapter eight, "Reclaiming the Garden by Force," serves as the culmination of the previous fossil visions and the powerful impact of fossil fuels on encouraging Americans to think of themselves as geological agents. It will demonstrate the use of technology and fossil fuels to find solutions to the arid West so that Americans could continue to view it as malleable. As rain follows the plow became an untenable dream, geology continued to be a significant element of how the region's past and future were conceived. It will begin by examining how Percival Lowell used Mars to talk about the fate of Earth and the necessity of irrigation. The science of irrigation came to the fore as rain follows the plow fell out of favor in the face of persistent drought. Through the work of William E. Smythe, the next section will focus on the social and soil science of the irrigation movement of the late nineteenth and early twentieth centuries. The State soon stepped in with the Carey Act and attempted to irrigate lands in arid states like Montana. As the case study in this chapter will demonstrate, often these efforts failed. At the turn of the century, the Reclamation Act was passed and took on projects of immense scale such as the one that Buffalo Bill started in Cody, Wyoming. Geology pervaded these discussions as Cody chose his site based on an ancient lake deposit, and with the aid of fossil fuels the Reclamation Service was seen as performing the work previously done by geologic

processes. The Milk River Reclamation project in Montana serves as an illustration of the scale of the social and environmental impacts of reclamation. Lastly, the chapter will examine the dry farming movement's origins in previous theories of western climate change and the role of Montana's railroads in continuing to boost for the West and spread visions of an agricultural paradise.



Figure 1. NASA Mars Lakebed Visual Restoration. Source: “Sediment Accumulation in Dry and Wet Periods,” Image Gallery, NASA Curiosity – Mars Science Laboratory, accessed April 16, 2015. https://www.nasa.gov/sites/default/files/thumbnails/image/pia19078_grotz-5_alluvial-3panel.jpg.

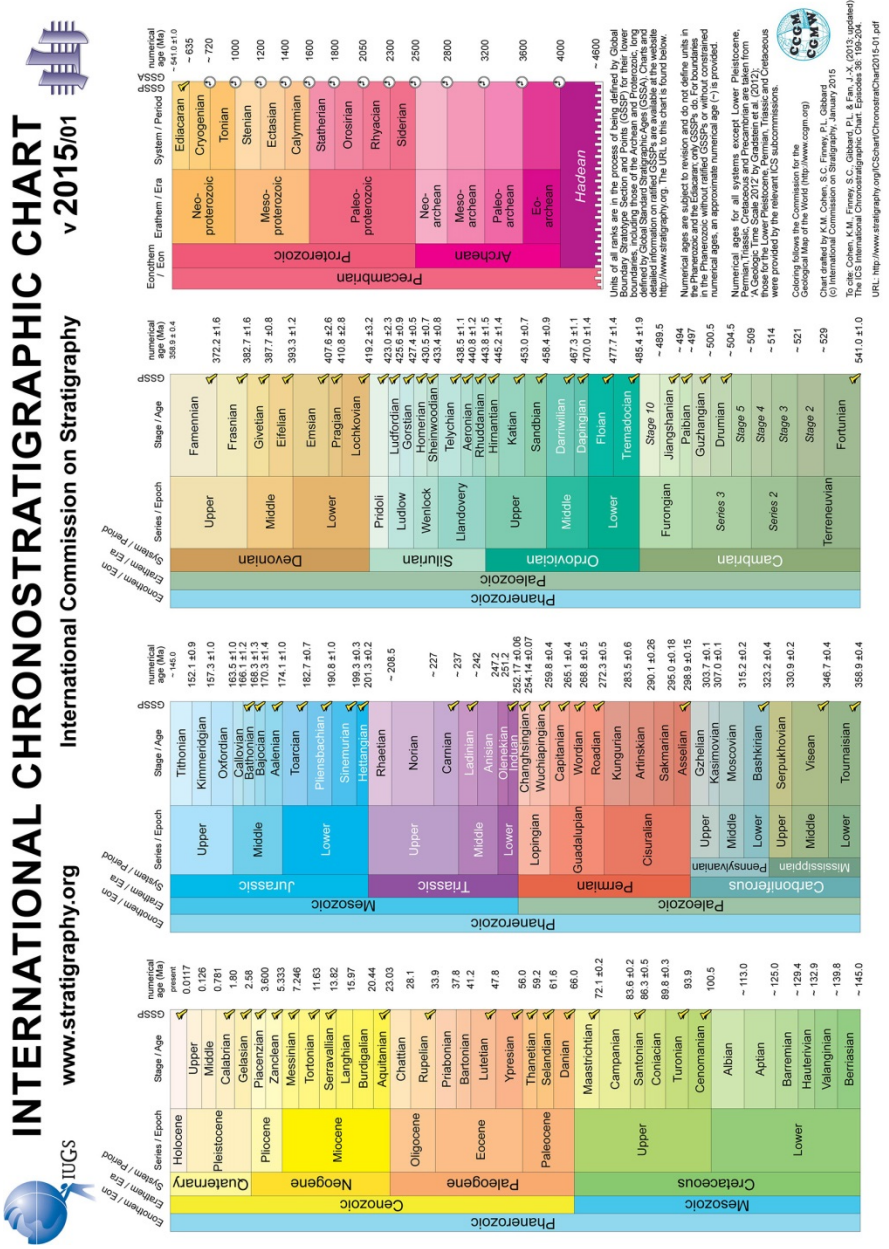


Figure 2. Chronostratigraphic Chart. Source: "International Chronostratigraphic Chart," International Commission on Stratigraphy, accessed March 31, 2015. http://www.stratigraphy.org/ICSchart/ChronostratChart2015-01.jpg.

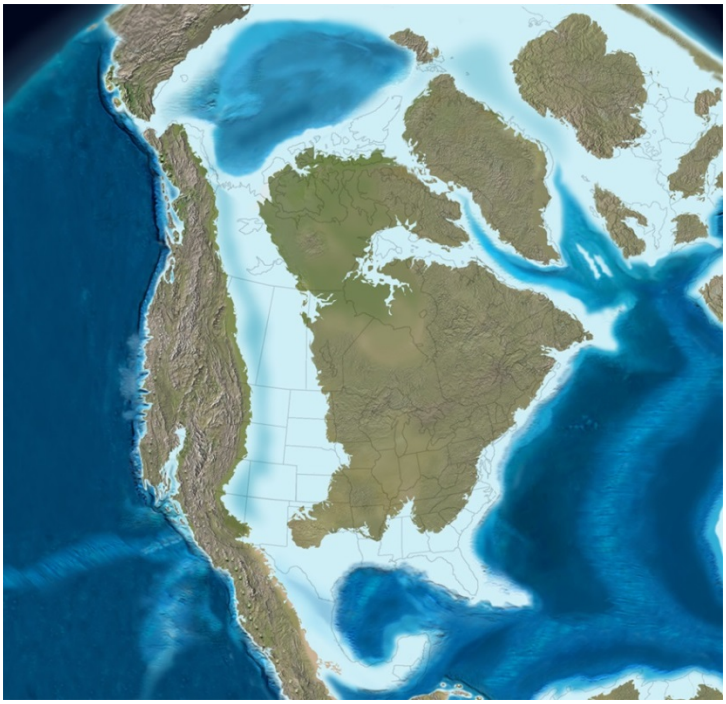


Figure 3. Late Cretaceous (85Ma). Source: Ron Blakey, Colorado Plateau Geosystems, Arizona USA.

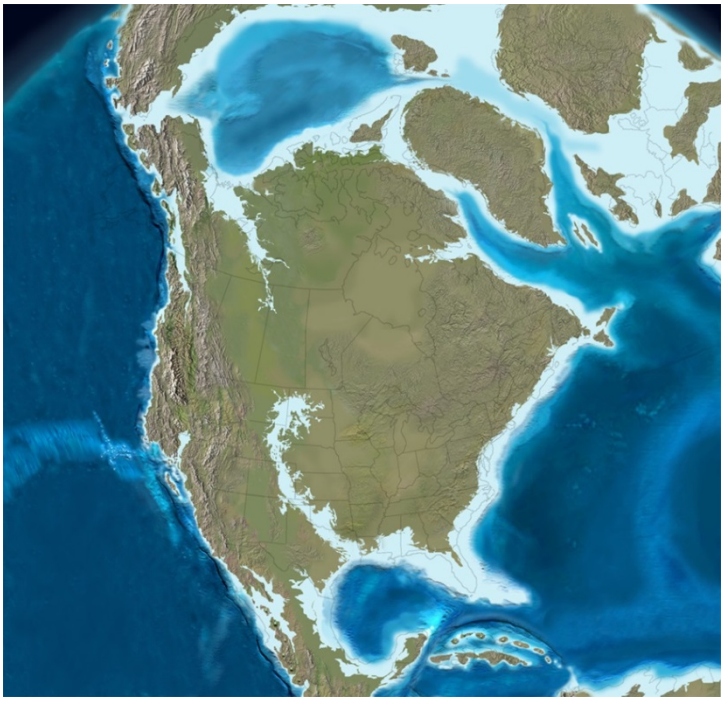


Figure 4. Cretaceous-Tertiary (65Ma). Source: Ron Blakey, Colorado Plateau Geosystems, Arizona USA.

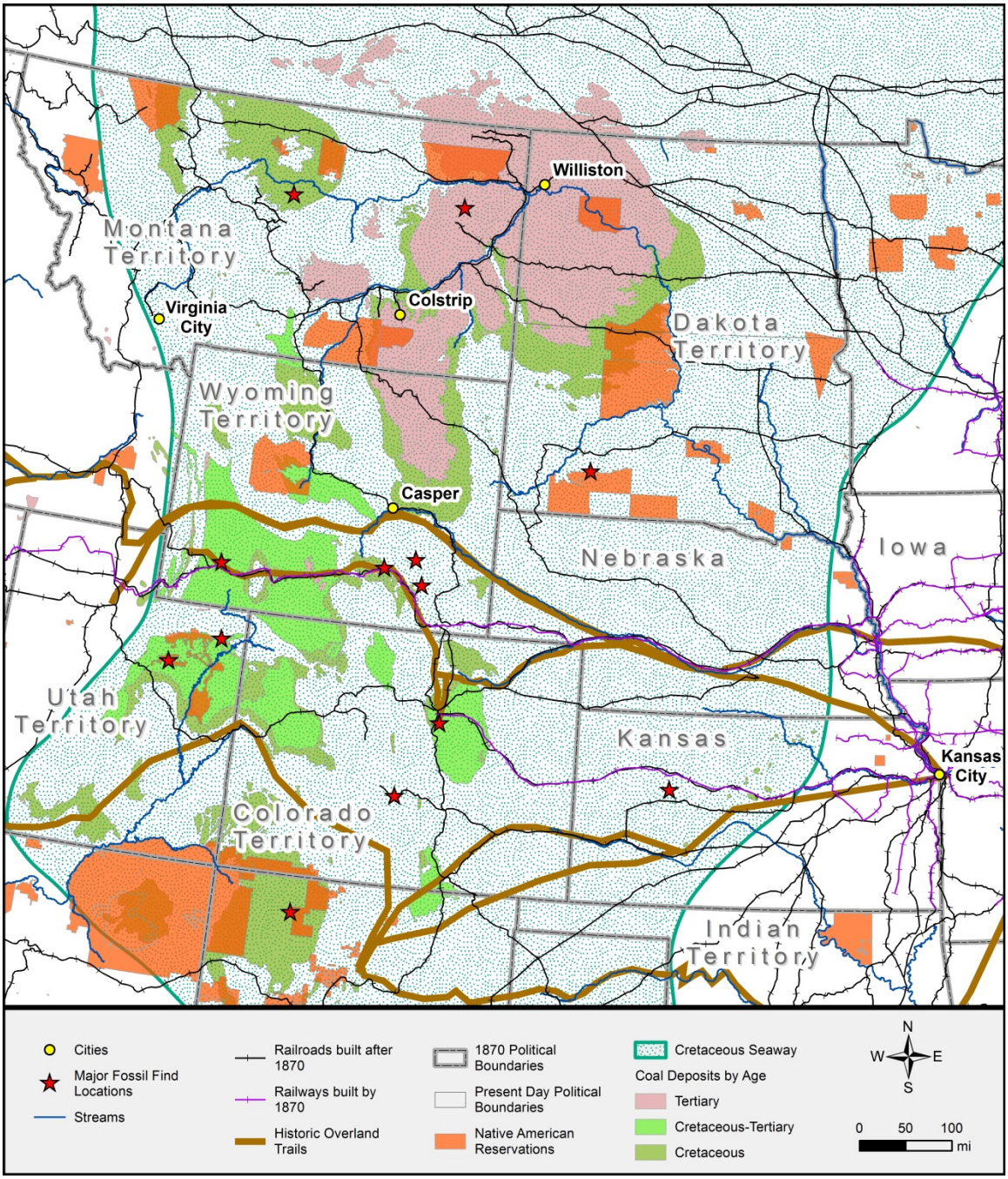


Figure 5. Map showing overlap of Coal, Fossil Finds, and Railroads. Created using ArcGIS by Elizabeth Zizzamia

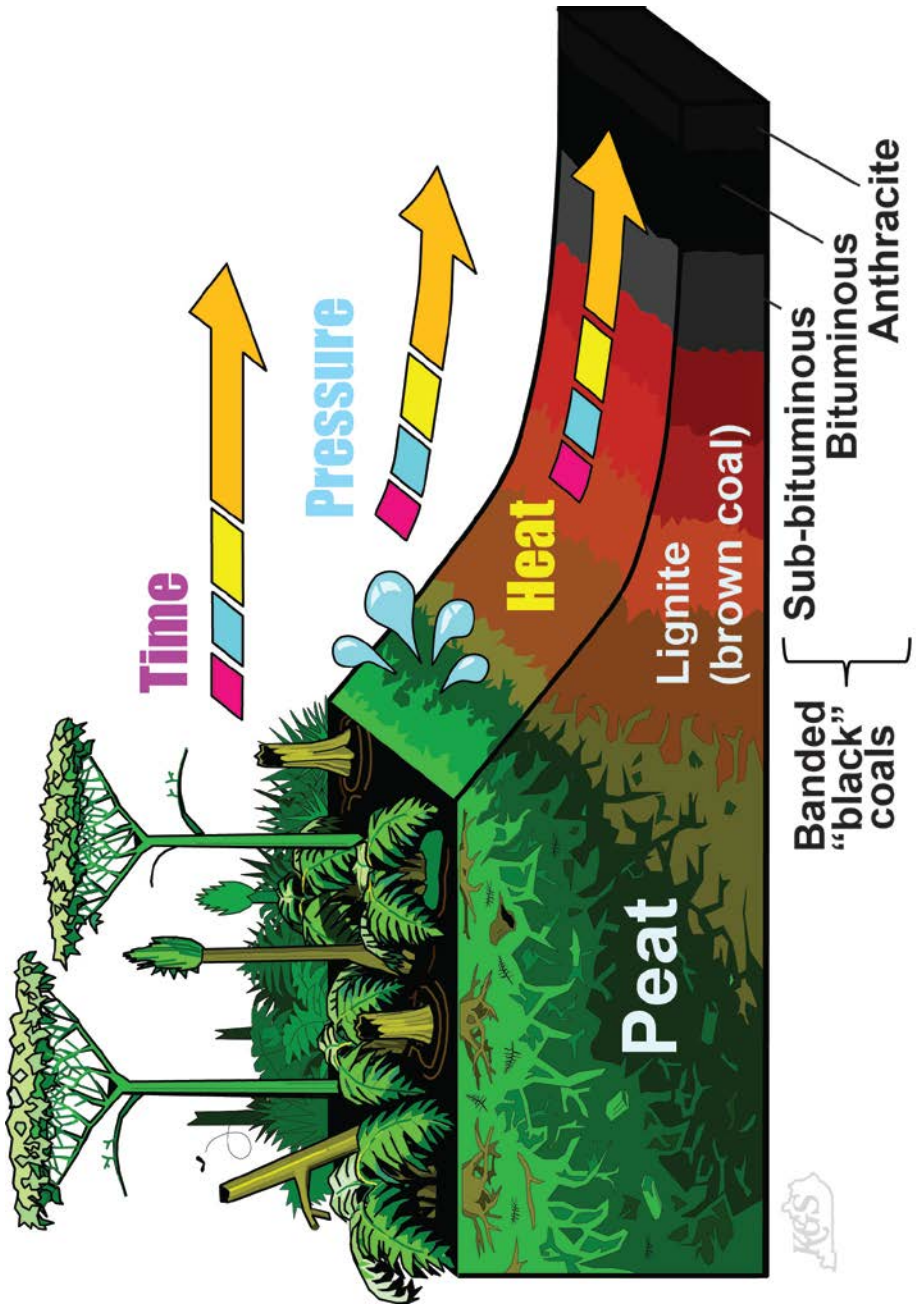


Figure 6. Coal Formation. Source: Stephen Greb, "How coal forms and coal rank diagrams," Kentucky Geological Survey, University of Kentucky, accessed March 25, 2015. http://www.uky.edu/KGS/coal/coalform_download.htm.

THE RED SEA TO THE DESERT WEST: THE IMAGINED AND PHYSICAL WEST OF THE EARLY NINETEENTH CENTURY

> we had a few drops of rain at Dark.— the Salts Coal & Burnt hills & Pumicston Still Continue, game Scerce this Countrey may with propriety I think be termed the Deserts of America, as I do not Conceive any part can ever be Settled, as it is deficent in water, Timber & too Steep to be tilled.[1]
> ~ William Clark in Montana Territory, May 26, 1805.

On May 26, 1805, William Clark was not optimistic about Montana's future. Climbing up a knoll on the western plains, the famous explorer had "beheld the Rocky Mountains for the first time with Certainty." On this clear and pleasant morning he felt a "Secret pleasure" from being so close to the source of the Missouri River which had up to this point seemed without end. Clark was hopeful, though cautiously so. He recognized the hardships that he and his companions would have to endure as they ventured into the snow covered mountains that barred them from the Pacific. His faith in the future success of the Expedition, however, could not save him from the very real environment that imposed its arid will on the party. Clark described the region as hellish and deprived of the garden-like characteristics he, Meriwether Lewis, and Thomas Jefferson had hoped that they would find on their journey. To be sure, the party found plenty of fertile western lands, but their encounter with the "Deserts of America" was far more jarring.

The area was a waste in Clark's eyes, but nonetheless he noted, "[w]e pass old Indian lodges in the woody points every day & 2 at our camp &c." For the Native

[1] Meriwether Lewis, William Clark, et al., May 26, 1805 entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1805-05-26.xml&_xslsrc=LCstyles.xsl.

Americans in this section of Montana, the environment was perfectly habitable. In their eyes, it was not a desert, but home. These two very different images of this western environment are hard to reconcile. Regardless of the physical characteristics of the land, one's worldview, technology, and practices shape how a place is understood. To a certain degree western landscapes could be many things at the same time. They could be a garden, home, ancient seaway, rolling plains, hell, or desert. For Americans, the mental and physical landscapes of the West were fluid geographies, colored by scientific data collected by explorers and men of science throughout the nineteenth century. Before the Civil War, the frontier was first understood as a garden and as the map of America was filled it became a desert.

Euro-Americans who settled the American West in the mid-to-late nineteenth century owed a debt of gratitude to Napoleon Bonaparte. With what one historian described as "the best land bargain ever made," the United States acquired France's Louisiana territory for $15 million (or 4¢ per acre), and the imperial drive westward across the expanding *terra (in)cognita* of North America began in earnest.[2] Armed with a set of beliefs about this expansive territory, Jefferson dispatched Lewis and Clark to follow the headwaters of the Missouri River and delve deeper into the uncharted West. Two particularly persistent dreams motivated Jefferson's rush to explore: the search for

[2] Stephen E. Ambrose, *Undaunted Courage: Meriwether Lewis, Thomas Jefferson, and the Opening of the American West* (New York: Simon & Schuster, 1997), 13.; See also, Charles A. Cerami, *Jefferson's Great Gamble: The Remarkable Story of Jefferson, Napoleon and the Men Behind the Louisiana Purchase* (Naperville, IL: Sourcebooks, 2003). I use the term "*(in)cognita*" because for many Euro-Americans it was a *terra incognita*, while for Native Americans and a number of traders and explorers of European descent the West was home and a well-known land.

the "Western Sea" that would provide a convenient course across the continent, and a confirmation of his suspicions of a garden-West. [3]

Dreams of the "Western Sea" and a "Passage to India" go at least as far back as Christopher Columbus's voyage to the Americas. Over time, however, this hoped-for sea retreated just over the horizon as explorers filled in the western landscape.[4] The "Western Sea" morphed from a giant body of water connecting the Occident to the Orient to an interior sea that flowed to the Atlantic and Pacific. Soon the sea shrank in size and withdrew into the mountains of the interior where it fed the many watery veins of the continent. Finally, it disappeared and was replaced with an elevated section of land occupying the continent's interior. The death of the "Western Sea," however, did not silence rumors of a Northwest Passage. The interior highlands could still be the source of mighty rivers flowing east and west. Dreaming of the riches of the Orient fueled imaginative journeys across the continent along western rivers and a painless portage up and over mountains to a rapid boat ride to the Pacific.[5] This dream excited the heart and mind of Jefferson and the goals of the Lewis and Clark Expedition.[6] Perhaps more significantly, this dream also set up conditions for thinking about the deep history and malleability of the West as California's status as an island was revised, and the garden-West was explored and became the desert-West. Western dreams of natural providence were amended and new scientific and technological visions took their place.

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[3] David Sievert Lavender, *The Way to the Western Sea: Lewis and Clark across the Continent* (Lincoln: University of Nebraska Press, 2001).; John Logan Allen, *Lewis and Clark and the Image of the American Northwest* (New York: Dover Publications, 1991).

[4] Much like the retreat of the Western Interior Seaway at the close of the Cretaceous.

[5] Allen, *Lewis and Clark and the Image*, xxii.

[6] Allen, *Lewis and Clark and the Image*, 14.; For a classic and comprehsive treatment of the exploration and geographic visions of North America from the conquistadors to Lewis and Clark, see Bernard Augustine De Voto, *The Course of Empire* (Boston, MA: Houghton Mifflin, 1952).

The mental landscape for seeing a watery West coalesced as early as the sixteenth century. Cartographers blended their dreams (and their audience's dreams) for the future of North America with reports related back to them by fearless explorers who entered the interior of the continent. The western region of North America remained a mystery to map makers for many centuries. By analyzing their changing visual representations of the American West over three centuries, it is evident that hopes for the future of the continent filled the gaps in cartographic knowledge. Until it was assessed through thorough exploration, the West remained a blank page filled only by hopeful visions. It was malleable in the imagination. Hopes and desires made the West what it was to become. In these early maps, the optimistic anticipation of a watered West drove further exploration, keeping alive visions like that of Jefferson's agricultural republic.

In time, the physical environment played a more formative role in defining the West's potential. But at first, the environment represented a barrier to accurate knowledge, a hostile place that was difficult to survey. Nevertheless, as the West was pondered and more fully explored it changed from a garden to a desert. Historians agree that many of the early representations of the West were imbued with optimistic visions of the region's future and that the region has long been shrouded in myth. Yet, they fail to link these early visions of the West had in common with later conceptualizations of the region. The West continued to be malleable even after it was coherently mapped. It was actually through the process of that mapping that the West was re-robed in its garden attire.

This chapter explores the groundwork set by early cartographers for envisioning a watery West in maps of California as an island. It then turns to the garden-West represented by Thomas Jefferson and the Lewis and Clark Expedition. Lastly, it demonstrates the rapid shift to a desert-West in the works of Zebulon Montgomery Pike and Stephen Harriman Long. Much of what occurred during this transition created conditions for the garden to once again take center stage after the Civil War. This chapter sets the stage for the instability of the West in the American imagination. The frontiers of geographical knowledge shifted from a sea to a garden to a desert. These topographies were colored by cultural objectives and defined how the region was settled and explored from the sixteenth to the nineteenth century.

The Northwest Passage and the Island of California: Cartographic Hopes for a Condensed Continent

Maps of the Northwest Passage and California as an island show the origins of a malleable West. There were shifting geographies at the edge of the known world. Rivers and a western sea were the secrets to a safe and successful journey to the riches of the Orient. Therefore, many hopeful early explorers and cartographers filled the empty spaces of North America with these features. Even as late as the nineteenth century, Jefferson's imagination swam in swift river currents that ran west.[7] Supporting this dream was an older vision of the West as a region of romance that held untold

[7] James P. Ronda, *Finding the West: Explorations with Lewis and Clark* (Albuquerque, NM: University of New Mexico Press, 2001), 1-14.

possibilities for a perfect future. The West was, in a sense, an empty vessel to be filled with dreams of riches and fertile fields.[8]

Substantial scholarly attention has been directed at the wrongheadedness of the maps depicting California as an island, but rarely have scholars considered the sea that once did separate these land masses. This section reveals the importance of this vision in assessing the region's value. Ultimately, the aridity of the region mattered less than the cartographic (and later scientific) representations that depicted a watery West. Western aridity was a significant environmental factor, but far more important to the later settlement and exploration of the region was its past and future waters. Furthermore, the island of California story shows that the nature of the West had long been reconciled with observed data, but nevertheless molded to suit cultural imperatives and dreams for the future of North America.

Around 1500, according to geographer Philip Hoehn, California debuted cartographically as a land of mythic proportions with extraordinary citizens.[9] The island of California soon migrated back to the continent of North America or, as the continent was often labeled, "America Septentrionalis," which translates to America of the north. However, in 1622, information passed to cartographers that reaffirmed the island nature of California.[10] This waterway between California and the North American continent was

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[8] Allen, *Lewis and Clark and the Image*, xxiv-xxv.; see also, Henry Nash Smith, *Virgin Land: The American West as Symbol and Myth* (New York: Vintage Books, 1950).
[9] Glen McLaughlin and Nancy H. Mayo, *The Mapping of California as an Island: An Illustrated Checklist*, 1st ed., Occasional Paper / California Map Society (Saratoga, CA: California Map Society, 1995), viii.; The following analysis of maps has been generated from the online Glen McLaughlin Map Collection of California as an island at Stanford University; "Glen Mclaughlin Map Collection," Stanford University Digital Collections, accessed January 14, 2014. http://lib.stanford.edu/california-as-an-island/.
[10] Seymour I. Schwartz, *The Mismapping of America* (Rochester, NY: University of Rochester Press, 2003), 143-153.

initially an unlabeled sea, and by 1636 it had been graced with the name "Mare Vermio" or "Mare Ver Mio" which translates to the Red Sea [Figure 7].[11] Depending on the country of origin of the author, through the following decades the sea subsequently took on the names "Mar Vermeio," "El Mar Rubrum," "The Vermian Sea," "Sea of Vermejo," "Mar Vermejo," "Mare Rosso," "Mer Rouge," "Mer Vermiglio," and "Eastern Red Sea" (For clarity, this dissertation will refer to it as the Red Sea).[12]

The French mapmaker Guillaume de Lisle explained the origin of this name in the year 1700:

> It was the Spanish who began [this belief]; all others believed that the Sea which separates California from New Mexico was a Gulf which terminated in a cul de sac; accordingly they gave it the name of Red or Vermillion Sea, because, said Wytflet, of its resemblance to the Red Sea which separates Arabia from Egypt.[13]

Examining the maps of California island that bear this sea, it is evident why the comparison had been made between the two bodies of water by the Flemish cartographer Cornelius Wytfliet. They look strikingly similar as if one were the mirror image of the other.[14]

What purpose did the sea serve cartographers? One answer lies in tales of the Northwest Passage. During his explorations of New France in 1673, Jacques Marquette came to recognize the Missouri River as the key to this cartographic mystery. As depicted in French sources, the Louisiana Territory was a lush garden of abundance, salubrious

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[11] "AMERICA SEPTENTRIO= NALIS" by Hendrik Hondius and Jan Jansson ,1636, in the "Glen Mclaughlin Map Collection," accessed January 24, 2014. http://purl.stanford.edu/cq445xf9935.
[12] "Glen Mclaughlin Map Collection."
[13] As quoted in Dora Polk, *The Island of California: A History of the Myth* (Lincoln, NE: University of Nebraska Press, 1995), 314.
[14] This could have reflected a cartographic approach to representing symmetry in the placement of landforms and bodies of water. The theory of symmetrical geography is discussed later in this chapter.

and full of mineral wealth.[15] Rivers were the vital veins of the West because they fed fertile plains and were routes to riches. Though it was often depicted as a short stream on many early maps, the Missouri River was described differently in text.[16] Marquette believed that the Missouri (or the *Pekitanouï* or "muddy" as he referred to it) formed an important part of the passage through the West. At its headwaters one could perform a short portage to another river that ran about 50 miles southwest to a small and deep lake from which a large river "flows toward the West, where it falls into the [Red] sea."[17] Marquette desired to reach the Vermillion Sea in good health so that he could "preach the Gospel to all The peoples of this new world who have so Long Groveled in the darkness of infidelity."[18] Even though it was central to Marquette's dream, the Red Sea existed only in his imagination, brought to life cartographically separating California from the continent of North America. Through its humble two-dimensional manifestations, the sea represented the abundance and potential of the West.

Maps that bore representations of California as an island also spoke to the hopes that many held about the riches of North America.[19] For example, below his 1679 map, John Seller described the treasures to be found on the North American continent. He noted that "[t]he whole Continent aboundeth with all things necessary for ye use of man not only for food as fish flesh & fruits but also for great quantitys of Silver that are found

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[15] Allen, *Lewis and Clark and the Image*, 2-4.
[16] Allen, *Lewis and Clark and the Image*, 5.
[17] Reuben Gold Thwaites, *Jesuit Relations and Allied Documents: Travels and Explorations of the Jesuit Missionaries in New France, 1610-1791,* Vol. LIX (Cleveland, OH: The Burrows Brothers Company, Publishers, 1899), 141-143.
[18] Thwaites, *Jesuit Relations*, LIX, 141-143.
[19] For a fascinating study of another imagined geography, see Sumathi Ramaswamy, *The Lost Land of Lemuria: Fabulous Geographies, Catastrophic Histories* (Berkeley, CA: University of California Press, 2004).

in ye bowels thereof."[20] The continent would certainly cater to the needs and desires of humanity [Figure 8]. Even if the continent did not deliver on these riches, the easy path that the Red Sea granted for travelers to the Orient surely promised a substantial return on one's journey across North America.

Before cartographers named the sea, it was assumed that a very large heart-shaped lake (also initially nameless) existed in the West that funneled out into the body of water between the North American continent and the island of California. The seminal representation of this large lake in the West was in the first English language representation of the island of California from 1625 [Figure 9]. On this same map, it was noted, "California sometimes supposed to be a part of ye westerne continent, but since by a Spanish Charte taken by ye Hollanders it is found to be a goodly Island…"[21] Later maps specified similar reasoning such as, "[t]his California was in times past thought to beene a part of y continent and so made in all maps but by further discoveries was found to be an Island long 1700 legues."[22] The lake connected to "[t]he Vermillion Sea" through a large, and judging by its represented width, navigable river named "R. del Norto" or North River that spilled into the southern part of the sea [Figure 10].

[20] "America" by John Seller, 1679, in the "Glen Mclaughlin Map Collection," accessed January 25, 2014. http://purl.stanford.edu/yd107yk8237.
[21] "The North part of America conteyning Newfoundland, New England, Virginia, Florida, New Spaine and Nova Francia, with ye riche Iles of Hispaniola, Cuba, Jamaica, and Porto Rieco, on the south, and upon ye west the large and goodly island of California" by Henry Briggs, Renold Elstracke, and Samuel Purchas, 1625, in the "Glen Mclaughlin Map Collection," accessed February 12, 2014. http://purl.stanford.edu/sy409bk9698.
[22] "A New and most Exact map of AMERICA" by John Overton, 1671, in the "Glen Mclaughlin Map Collection," accessed February 2, 2014. http://purl.stanford.edu/fy697rn5092.

By 1655, the lake acquired a formal name, "Lac de Conibas," on many maps of California as an island.[23] The name was taken from a region that surrounded the lake named "Conibas" which first appeared on these maps in 1647.[24] The lake and surrounding region had their origins in earlier maps from the sixteenth century. Often, it had an outlet that flowed into a larger body of water. The lake entered onto the cartographic stage as early as 1575 on a map by André Thevet who drew the lake draining to the north into a larger sea.[25] A 1593 map by Cornelius de Jode showed the Northwest Passage along the top of the map connected to the "Lago de Conibas"[26] In 1597, Conibas was granted the status of a region with the usual hyperbole of an area shrouded in myth. Cornelius van Wytfliet, the man who named the Red Sea of the West, named the region "Conibas Regio" and depicted it as a populated region with large castle-like structures adorning the local towns.[27] It is possible that Lake Conibas was in fact a representation of Hudson Bay, James Bay, Lake Ontario, or all of the Great Lakes.[28] An example of this can be seen in Pierre Duval's 1679 map that depicted the Great Lakes as a series of lakes that were open ended at their most western reaches [Figure 11].[29] The level of uncertainty present on these maps makes it clear that the watery frontier was a mobile geography. Cartographers were not only depicting a western

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[23] "Glen Mclaughlin Map Collection" http://purl.stanford.edu/dp832wf8309. "AMERIQUE Autrement NOVVEAV MONDE et INDES OCCIDENTALES" by Pierre Duval, 1655.
[24] "TOTIVS AMERICÆ NOVA ET EXACTA TABVLA EX OPTIMIS TVM GEOGRAPHORVM, TVM ALIORVM" by Per Corn Dankervm, 1647, in the "Glen Mclaughlin Map Collection," accessed January 12, 2014. http://purl.stanford.edu/tf486tz1347.
[25] R.C. Davis and R.I. Ruggles, *Rupert's Land: A Cultural Tapestry* (Waterloo, Ontario, Canada: Wilfrid Laurier University Press, 1988), 18.
[26] Schwartz, *The Mismapping of America*, 82-83.
[27] Davis et al., *Rupert's Land: A Cultural Tapestry*, 18.
[28] Davis et al., *Rupert's Land: A Cultural Tapestry*, 18.
[29] "LA MER DE NORT ou sont LA Nle." by Pierre Duval, 1679, in the "Glen Mclaughlin Map Collection," accessed January 14, 2014. http://purl.stanford.edu/jy081yq8216.

sea, but they were illustrating that regions to the west abounded with water. On these late sixteenth century maps, California is not always an island, but a watery passage leading through the North American continent was alive and well into the next century and beyond.

For example, in a 1660s map where California is an island, a huge "300 miles long" lake was situated in the West. It was open-ended and connected with a river that crossed from the Gulf of St. Lawrence through the entirety of the continent. The incomplete portion suggested that it could link up with another river named the "R. d. North" (or North River) that led directly to the sea between the island of California and the North American continent [Figure 12].[30] The lake was often depicted during the late seventeenth century as surrounded by mountains with the North River leading through a valley between two large mountain chains. When California was represented as an island, bodies of water in the West did not necessarily have to connect to a northern passage; they could flow southwest through an outlet into the Red Sea. Lake Conibas existed for at least one hundred years and flowed into the Red Sea well into the mid-eighteenth century as a lake without a name.[31]

At times during the late eighteenth century, the North River flowed into the Gulf of Mexico rather than the Red Sea. While its direction fluctuated, Lake Conibas also began to fade in and out of cartographic imaginations as the North River seemed to flow from the mountains rather than that large lake of the West. The passage of the North

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[30] "A NEW, Plaine, and Exact Map of AMERICA" by Robert Walton, [1660?], in the "Glen Mclaughlin Map Collection," accessed February 14, 2014. http://purl.stanford.edu/bx376jn7462.
[31] "Glen Mclaughlin Map Collection."; For example, "A New and Correct Map of the WORLD from the latest Observations" by John Senex, 1749, "Glen McLaughlin Map Collection," accessed February 30, 2014. http://purl.stanford.edu/kz015wy5926.

River into the Red Sea from Lake Conibas appears to disappear around the same time that large northern river passages were described and depicted cartographically. This occurred around 1711 with a river named "R. Longue" that became the dominant representation of the passage to the West in maps of North America by the mid-1720s [Figure 13].[32] This was also when Lake Conibas began to disappear from maps. The absence of Lake Conibas from maps which bear the Longue River indicates that these two features served the same cartographic purpose in representing the hopes and dreams of the West.

Yet, at the commencement of the eighteenth century, there were those who resisted the draw of this dream. Jesuit missionary-explorer Father Eusebio Kino established that California was in fact not an island. Likewise, the exacting cartographer Guillaume de Lisle questioned California's status as an island as early as 1700 and faulted the Spanish for perpetuating this mythical geography.[33] Nevertheless, it took about 100 years for that myth to vanish.[34] Caution was no doubt warranted. Dreams of the island of California added to the dramatic financial controversy surrounding England's "South Sea Bubble" as cartographer Herman Moll used the Red Sea passage as proof of the trading capacity of the South Sea Company.[35] The island of California was even parodied by Johnathan Swift in his 1726 *Gulliver's Travels* as the island of Brobdingnag, where giants roamed and where even larger giants existed as revealed by

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[32] "A NEW MAP of the WORLD according to the New Observations" by Herman Moll, [1711?], "Glen Mclaughlin Map Collection," accessed January 14, 2014. http://purl.stanford.edu/tx385st3900.
[33] Polk, *The Island of California*, 313-317.
[34] McLaughlin and Mayo, *The Mapping of California as an Island*, viii.; Polk, *The Island of California*, 295-302.
[35] Polk, *The Island of California*, 312; Gillian Hutchinson, "Herman Moll's View of the South Sea Company," *Journal for Maritime Research* 6, no. 1 (2004): 87-112.

fossil evidence.[36] In 1747, the issue was commandingly settled by royal decree as Ferdinand VI declared, "California is not an island."[37] By 1757, California's island status had been revoked and most understood the region to be firmly connected to the continent.[38]

Despite these denunciations, for the overly optimistic California's island status persisted well into the middle of the eighteenth century. Some firms even sold maps depicting California both as an island and as a part of the North American continent so as to cater to the dreams of their customers.[39] This dualistic representation was also evident in the flow of the river from the lake of the West, which fluctuated in the maps in the early 1700s. Even in virtually identical maps by the same cartographer, one would depict the river as flowing to the Red Sea while the other showed it flowing to the Gulf of Mexico. Some representations would split the difference and depict the lake of the West as emptying into a river that flowed to both the Red Sea and the Gulf of Mexico [Figure 14].[40]

Cartographers who believed that an isthmus connected the island to the mainland also advanced the suggestion that California was both an island and a peninsula. Resistance to this compromise was mustered by many who maintained that the isthmus

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[36] Polk, *The Island of California*, 311-312; Jonathan Swift et. al., *Gulliver's Travels* (Oxford: Oxford University Press, 2005), Chapter VII.
[37] Polk, *The Island of California*, 326.
[38] Polk, *The Island of California*, 311.
[39] Polk, *The Island of California*, 313.
[40] For example: "AMERIQUE SEPTENTRIONALE divisée en ses principales parties, ou sont distingués les vns des autres LES ESTATS suivant qu'ils appartiennent presentemet aux FRANÇOIS, CASTILLANS, ANGLOIS, SUEDOIS, DANOIS, HOLLANDOIS. Tirée des Relations de toutes ces Nations Par le S. Sanson, Geographe Ordinaire du Roy" by Nicolas Sanson and Alexis Hubert Jaillot, 1719, in the "Glen Mclaughlin Map Collection," accessed January 14, 2014. http://purl.stanford.edu/cy999sm3297.; "AMERIQUE SEPTENTRIONALE…" by Nicolas Sanson and Alexis Hubert Jaillot, 1719, in the "Glen Mclaughlin Map Collection," accessed January 14, 2014. http://purl.stanford.edu/ck526sd4677.

was typically submerged by the tides.[41] However, even as the island of California disappeared, dreams of a profitable passage west thrived. The elusive Northwest Passage proved an enticing fantasy. The British sent James Cook in 1776 to explore the upper reaches of the Pacific coast, but he was forbidden access to the fabled region by his ship's inability to penetrate ocean ice.[42]

The motivation to keep California as an island prolonged the perception of a condensed land passage across the continent. [43] These maps eased the passage across the continent. For English optimists, to abandon the island myth would mean to destroy a dream.[44] Herman Moll, mentioned above, exemplified this unwillingness to face the facts brought forth by Kino. Because it suited his cartographic vision, Moll would rather embrace the initial discovery of California as an island by Ferdinand Cortez in 1535.[45] His persistence demonstrates the strength of optimistic environmental perceptions like those that later helped to settle the West.

Moll may have been the most prolific visionary in dreaming California as an island and the search for a Northwest Passage. His faith in the Northwest Passage could be seen in his 1705 map. "This Draught of the NORTH POLE is to shew all the Countries near and adjacent to it as also the most remarkable Tracks of the Bold Discoverers of them, and Particularly the Attempts of our own Countrymen to find out the N.E. aft and N.West Passages." The inset map showed two interconnected lakes on the northern

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[41] Polk, *The Island of California*, 319.
[42] Polk, *The Island of California*, 327.
[43] An analysis of Glen McLaughlin's extensive map collection of California as an island shows that the most recent European representation of California as an island cartographically is 1809 in James Cundee's map published in London; Unknown name from an unknown publication, James Cundee, 1809, in the "Glen Mclaughlin Map Collection," accessed January 18, 2014. http://purl.stanford.edu/rx785xf5571.
[44] Polk, *The Island of California*, 309.
[45] Polk, *The Island of California*, 101, 309.

portion of North America leading towards the sea that separated California from North America and the Northwest Passage.[46] Moll's 1711 map showed California as an island and the "R. Longue" leading west from the "Misisipi R." to reach, with a seemingly short portage, the Northwest Passage.[47] In 1719, Moll's map of the world contained the same river structure as the map from 1711, with more detail and an additional name to the river, "Morte R" [Figure 15]. Above and below this northern river was an area labeled "Parts Unknown" encompassing the West where there are "High Mountains" labeled where the Rocky Mountains would later be made manifest. The Rockies did not look in any way forbidding and were a single line of mountains that ran north to south with a break in them that allowed a river to flow through in close proximity to the most western extent of the "Morte R. or R. Longue."

In order to put to rest any doubts of his accuracy, Moll took care to assure his readers in an "Advertisement" that he "omitted no Pains to have them very correctly done" using "the Newest Observations and latest Discoveries." It was his sincerest hope, Moll claimed, that people would not "suffer themselves to be imposed upon by Old, incorrect and falsly projected Maps."[48] He guaranteed that he had worked diligently to

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[46] "This Draught of the NORTH POLE is to shew all the Countries near and adjacent to it as also the most remarkable Tracks of the Bold Discoverers of them, and Particularly the Attempts of our own Countrymen to find out the N.E. aft and N.West Passages" by Herman Moll, 1705, in the "Glen Mclaughlin Map Collection," accessed January 21, 2014. http://purl.stanford.edu/vy990vb3853. Moll used the Spanish term for the Northwest Passage, the "S. of Annian."

[47] Moll again used the Spanish term for the Northwest Passage, the "Str. of Annian."; "A NEW MAP of the WORLD according to the New Observations" by Herman Moll, [1711?], in the "Glen Mclaughlin Map Collection," accessed March 21, 2014. http://purl.stanford.edu/tx385st3900.

[48] "A new & correct map of the whole world" by Herman Moll, 1719, "Glen Mclaughlin Map Collection," accessed January 30, 2014. http://purl.stanford.edu/fq505jv7833. Moll defended his accuracy on the basis of his use of the Mercator projection and the use of the latest geographic knowledge. He criticized Moses Pitts for using old maps and falsely calling upon the authority of credible individuals to bolster the authority of his "New Atlas." As a business man and a cartographer, Moll was calling upon the ever-increasing weight of authority derived from science and technology.; For a historical examination of the

create a quality product that was far superior to other suspect maps that led cartographic audiences astray. He knew full well that maps could mold minds and shape the world. Moll also was aware that a plea to the authority of technique was an effective rhetorical device to convince his audience of the credibility of his environmental visions.

Moll called upon an oft-cited source that was regularly referenced on maps depicting paths across the continent. In another version of this map from 1719, Moll stated the following above adjoined lakes along the northern section of North America,

> The Baron Lahontan in his first book pag; 125 says that some of the Mozeemleck nation told him that the distance of 150 Leagues their principal river empties it self into a Salt Lake 300 Leagues in circumference, the mouth of wich is about two Leagues broad. That ye lower part of that River is adorn'd with six noble Cities besides a hundred Towns, great an small, round that sort of Sea and that ye People call themselves Tahuglank &c.[49]

According to his source, not only was there a passage across the continent, there were large bodies of water and signs of civilization. His representations of these features supported the notion of a Northwest Passage and continued to be present on his maps until at least 1741.[50]

Moll's cartographic dreams were in many ways representative of the hopes inherent in the Lewis and Clark Expedition.[51] This path to the ocean from a large lake in

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nature of constructing authoritative geographic knowledge, see: Charles W. J. Withers, "Reporting, Mapping, Trusting: Making Geographical Knowledge in the Late Seventeenth Century," *Isis* 90 (1999): 497-521.

[49] "The World Described" Map 7, by Herman Moll, 1719, in the "Glen Mclaughlin Map Collection," accessed February 15, 2014. http://purl.stanford.edu/hy431kv1138.

[50] "A New Map of North AMERICA According to the Newest Observations" by Herman Moll, 1741, in the "Glen Mclaughlin Map Collection," accessed January 12, 2014. http://purl.stanford.edu/yn959jw9550.

[51] While some historians have asserted that Herman Moll's maps contributed to the cartographic knowledge underlying Lewis and Clark's expedition, John Logan Allen doubts that his fantastical vision played a major role in Jefferson's vision.; Allen, *Lewis and Clark and the Image*, 87.

the center of the continent fed into the image of the passage to the "Western Sea" that Jefferson instructed Lewis and Clark to find. Furthermore, Moll's use of the Baron Lahontan as a reputable source for information about a river passage west was not unique. For example, on a map first published in 1710 and later in 1720 by the title of, "North America Corrected from the Observations Communicated to the Royal Society at London, and the Royal Academy at Paris," its creator George Willdey stated,

> The Long River or Dead River was discovered lately by the Baron Lahontan as far as is marked in the Map, that which is more to the Westward was Drawn by the Savages of the Nation of Gnaesitares on Dearskins. Unless the Baron Lahontan has invented these things, which is hard to resolve he being the only Person that has Traveled into these vast Countries.

It also indicated that "[a] Lake of Salt water 30 Leagues wide and 300 about according to the report of the Savages, who also say that the Mouth of it is at a great distance from the South Coast and is but 2 Leagues broad, that thereis above 100 town about it: And they sail on it with large Boats." There were two lakes connected by the Dead River and the most western lake terminated with a chain of mountains. Directly on the other side of the mountain chain was another wide river that flowed into this large salt water lake that had no southern termination point, but rather flowed into an area labeled "INCOGNITA" [Figure 16].[52] The series of interconnected rivers described by Baron Lahontan persisted on maps well into the 1780s and most certainly contributed to Jefferson's vision of the wonders and watered geography contained within the Louisiana Purchase.[53]

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[52] "[NORTH AMERICA]" by George Willdey, 1720, in the "Glen Mclaughlin Map Collection" accessed January 16, 2014. http://purl.stanford.edu/gz393fx6652.

[53] "A NEW AND CORRECT MAP of the WORLD Laid down according to the Newest Observations & Discoveries In several different Projections: Including ye Trade Winds Monsoons Variation of the

The British, however, fashioned an alternative vision that would later become dominant, one that differed dramatically from Jefferson's and the French's garden-West.[54] The British tended to see the West as the natural desert home of Native Americans rather than a garden to be tilled by white men.[55] An example of this can be seen in a 1704 map by Edward Wells in which California is an island [Figure 17]. Close to the shore of the "Golf of California or Vermillion Sea" is an area labeled "Discovered about 1540, of a barren soil and little known," and to the north is the label "Parts As Yet Unknown."[56] Nevertheless, some held out hope that the climate of the interior would improve steadily with the clearing of wood and settling of the land.[57] This belief was very similar to the subsequent "rain follows the plow" theory that animated the hopes of many western settlers. The conviction that the West was barren, however, did not stop the British from believing in a river passage across the continent.

There were a number of theories in circulation that, regardless of its possible desert character, made the West an enticingly navigable region. The theory of symmetrical geography provided support for the passage. In this case it meant that the mountain source of the Missouri would have a symmetrical river on its opposite side

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Compass and Illustrated with a Cœlestial Planisphere, the various Systems of PTOLEMY, COPERNICUS, and TYCHO BRAHE Together w.th ye Apearances of the Planets &c." by Charles Price, Richard Marshall, William Godson, [1785], in the "Glen Mclaughlin Map Collection," accessed March 20, 2014. http://purl.stanford.edu/md377hq5426.; This map contains the "Dead R." with four lakes leading into the west with the "Missouri R." being a separate river south of it. Below the four lakes the map reads "To this Place the Baron Lahontan Traveled." The final lake ends short of another lake to the north that flows into a very large lake to the west. The region to the west of the lake is absent any river or names. "The supposed Straits of Annian" are labeled to the northwest in the area of the map that is devoid of content – obviously unexplored areas.; Allen, *Lewis and Clark and the Image*, 8-9.

[54] Allen, *Lewis and Clark and the Image*, 4.

[55] Allen, *Lewis and Clark and the Image*, 18.

[56] "A New Map of NORTH AMERICA Shewing its Principal Divisions, Chief Cities, Townes, Rivers, Mountains, &c." by Edward Wells, 1704, in the "Glen Mclaughlin Map Collection," accessed January 20, 2014. http://purl.stanford.edu/jc636bs9794.

[57] Allen, *Lewis and Clark and the Image*, 18.

running to the ocean of the West.[58] Another theory held that the center of the continent contained an elevated point that was the origin from which all rivers flowed. This "pyramidal height-of-land" theory suggested that if one found this central point, they could ride one of the four rivers (in a pyramidal orientation with each of the faces representing a drainage) that flowed from it to any of the seas surrounding the continent.[59] It was also believed that if a portage across a mountain range in the West was needed, it would be a trifling matter. The idea of the paltry portage was supported by the British view of the mountains of the West as a minor range and later allegedly proven by Alexander Mackenzie of the Northwest Company in 1793.[60]

During the eighteenth century, the British were also scouting the passage from the West coast, continuing a project began by the Spanish in the sixteenth century. This Spanish imperial venture aimed at locating and navigating the western end of the Northwest Passage, known as the "Straits of Anian." On seventeenth and eighteenth century maps, the Straits of Anian functioned as a possible passage through northern North America. For example, a very distinct channel labeled Straits of Anian funneling into the seas of the West can be seen in a 1680 map by William Berry and Nicolas Sanson [Figure 18]. The strait was drawn incomplete flowing from the east, and its open

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[58] A major proponent of this theory, Daniel Coxe, author of the 1722 text *Carolana* that promoted his family's land holdings, maintained that further exploration over the large mountain ranges of the West would reveal navigable rivers that flow to the ocean of the West. The British held steadfast to this symmetrical theory throughout the rest of the century and as it became cartographic orthodoxy it made it into the maps of prominent cartographer Aaron Arrowsmith and the mind of Thomas Jefferson.; Allen, *Lewis and Clark and the Image*, 19.

[59] Allen, *Lewis and Clark and the Image*, 23.

[60] During the late eighteenth century, the Columbia River was also discovered and early explorers believed it to be the Great River of the West. One of these early adventurers, Lieutenant Broughton, ventured inland and soon saw "Mount Hood" and assumed it was part of the same mountain chain that served as the source of the Missouri. The belief in a short portage had gained further evidence – the Columbia and the Missouri constituted a continental passage to unite the seas.; Allen, *Lewis and Clark and the Image*, 27-38.

ended nature suggested that its full extent was simply yet to be discovered.[61] The Straits of Anian persisted as a possible Northwest Passage well into the late eighteenth century.[62]

This period also saw the Spanish obtain control over Louisiana at the conclusion of the French and Indian War. Compared to other European powers, the Spanish brought a more measured approach to mapping and speaking about the West and therefore diluted some of the mythology. Fear of encroachments from the newly independent Americans and enterprising Russian and British trader-explorers paired with fur trader aspirations to find the elusive watercourse to the Pacific, spurring the Spanish to explore and control the Missouri River and its associated drainages. Spanish excursions up-and-around the Missouri generated further details indicating landmarks and features that characterized the upper Missouri and the belief that the river was navigable up to its source in the mountains.[63]

As mentioned earlier, in 1700 cartographer Guillaume de Lisle blamed the Spanish for perpetuating the myth of California as an island. It may also be the case that myths concerning the interior of the continent of North America were inadvertently encouraged through the cautious Spanish approach to revealing cartographic information to their North American imperial competitors. Ironically, by unintentionally preserving older geographic myths about the continent, such caution may have spurred those very

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[61] "NORTH AMERICA Divided into its PRICIPALL PARTS..." by William Berry and Nicolas Sanson, 1680, in the "Glen Mclaughlin Map Collection," accessed February 8, 2014. http://purl.stanford.edu/ph181rd0542.
[62] Allen, *Lewis and Clark and the Image*, 31.; Godfrey Sykes, "The Mythical Straits of Anian." *Bulletin of the American Geographical Society* 47, no. 3 (1915): 161-172.; De Voto, *The Course of Empire*, 62-63.
[63] Allen, *Lewis and Clark and the Image*, 40-42.

same competitors to encroach on Spanish territory in hopes of locating fabled riches and trade routes. Under the leadership of Jefferson, Americans would find these mysteries too enticing to ignore. The instability of the frontier's geography depicted above drove exploration into the interior.

American hopes of an agricultural future for the West in the fashion of the Jeffersonian yeoman farmer ideal overrode the reports that spoke of a desolate and infertile West. In the early nineteenth century abundant sources also confirmed this faith in fertility. The idea that the West had amazingly rich soils and a beautiful, healthful, comfortable climate permeated the hopeful minds of Americans.[64] In the interior, one could find a continent of rivers that made the Nile River a mere rivulet in comparison. Most eighteenth-century authorities agreed that the interior of North America was bound to be a fluvial paradise abounding in opportunities for mills and agriculture. Many also believed that the rivers were navigable and the portages between them were passable, being that very little was known about the Rocky Mountains. While Americans were not prone to unbounded fantasy concerning the West, there were also romantic tales of Native Americas, reports of a gigantic mountain of rock salt along the Missouri, and a series of fiery volcanoes in the interior.[65] The West was a mystery that was malleable in the minds of Americans. In its unexplored lands lay untold potential. It was left to one man to push America across the continent and discover the secrets of the mysterious West, Thomas Jefferson.

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[64] Allen, *Lewis and Clark and the Image*, 52; Smith, *Virgin Land*, 12.
[65] Allen, *Lewis and Clark and the Image*, 50-52.

Jefferson's Dreams and the Lewis and Clark Expedition into the Garden-West

Jefferson's strategy for the Louisiana Territory consisted of two basic elements. The first was to assimilate Native Americans into the United States through commerce. The second, and ultimate goal, was to settle the fertile West with yeoman farmers. To achieve these objectives, Jefferson advanced the Lewis and Clark Expedition. Entrenched in the culture of American expansion, these men could not help but to see the region through the lens of their benefactor. Through Jefferson's economic goals and agricultural vision of a watery West, and the fertile frontier seen by Lewis and Clark, this section illustrates the limits of Humboldtian and Baconian scientific exploration and the pliability of the frontier.

Jefferson was not alone in his western wonderment. Geographer Jedidiah Morse, father of Samuel Morse of telegraphy fame, believed that the West held amazing potential for future settlement in its fertile fields. "[W]e cannot but anticipate the period," Morse prophesized, "as not far distant, when the AMERICAN EMPIRE will comprehend millions of souls, west of the Mississippi." Morse believed that "the Mississippi was never designed as the western boundary of the American empire. The God of nature never intended that some of the best part of this earth" should be put in the hands of distant empires.[66] Jefferson had analyzed settlement patterns of the citizens of the United States in the late eighteenth century and determined that in no short period of time, settlers would, even in the face of hostile Native Americans, populate the entire

[66] Jedidiah Morse, *The American Geography; or, A View of the Present Situation of the United States of America* (London: 1792), 469.

continent.[67] However, this rather accurate vision, and his dreams of gardens and rivers were temporarily put on hold in favor of a more politically palatable economic goal. Native Americans were to retain their land west of the Mississippi and science was to dominate explorations into the West. The scientific and cartographic knowledge thus gleaned was to be put to economic and political goals of dominating lucrative trade markets.[68]

Jefferson wanted the United States to enter the region as a commercially competitive imperial power amongst the European nations actively trading with the Native Americans.[69] North American geopolitics soon set his imagination aflame. In November of 1802, Jefferson was informed that the Spanish had ceded the Louisiana Territory back to France and he became hopeful that an expedition could be executed into the region. From his hope sprang plans for an expedition that he revealed in a secret message to Congress on January 18, 1803. Along with adding geographic and scientific knowledge to the new Republic, Jefferson's stated goal was to pacify and enter Native Americans into an agricultural existence that would reduce their need for large expanses of subsistence lands and envelop them into American markets as producers and consumers of goods.[70] Cloaked in the language of concern for the future welfare and assimilation of Native Americans, Jefferson's proposal to explore the West was justified on the basis of extending trading pathways to better supply Native Americans with the

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[67] Smith, *Virgin Land*, 11-12.
[68] Smith, *Virgin Land*, 16-17.
[69] James P. Ronda, *Lewis and Clark Among the Indians* (Lincoln: University of Nebraska Press, 2002), 1-4.
[70] President Thomas Jefferson's confidential message to Congress concerning relations with the Indians, January, 18, 1803; Record Group 233, Records of the United States House of Representatives, HR 7A-D1; National Archives. http://www.ourdocuments.gov/doc.php?flash=true&doc=17.; For more information on how Jefferson saw Native Americans, see: Peter S. Onuf, "'We Shall All Be Americans': Thomas Jefferson and the Indians," *Indiana Magazine of History* 95, no. 2 (1999): 103-141.

cultural necessities of white material existence.[71] Given these justifications, the fiscally minded Congress granted its approval on February 28, 1803, and $2,500 was appropriated for the western adventure (though more like $38,722.25 was spent). However, this economic goal was the first step in Jefferson's plan for the region. The West would be not simply an empire of trade, but the basis for the budding American agricultural Republic.

A flurry of activity ran up to the departure of the Lewis and Clark Expedition. President Jefferson and Secretary of the Treasury Albert Gallatin pondered the geography of the West and gathered the most advanced cartographic references to supply the exploratory outfit with the most up-to-date geographic knowledge. Meanwhile Lewis was likewise exploring the state of geographic knowledge and taking crash courses on scientific methodology.[72] Into these maps slipped representations of what contemporaries wished the world to be. Cartographers typically did their utmost to accurately represent the geography of the West, but there is no denying that map making is an artistic endeavor that requires the interpretation of available data. A lack of trustworthy data allowed for gaps to be filled with culturally-driven decisions derived from popularly held hypotheses.[73] No doubt maps were judged for their veracity and could not be pure flights

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[71] Allen, *Lewis and Clark and the Image*, 70-72.; Jefferson's sentiments would echo into the late nineteenth century when assimilationist legislation was passed that infused Jefferson's agrarian Republic and garden-West visions into a method to assimilate Native Americans by imposing an agrarian lifestyle and dividing up reservations through the Dawes Act.

[72] Allen, *Lewis and Clark and the Image*, 74, 79, 90.; Thomas C. Danisi and W. Raymond Wood, "Lewis and Clark's Route Map: James Mackay's Map of the Missouri River," *The Western Historical Quarterly* 35, no. 1 (2004): 53-72.

[73] For a discussion of western promise instead of western realities embedded in maps constructed before the Civil War, see: John Logan Allen, "Patterns of Promise: Mapping the Plains and Prairies, 1800-1860," *Great Plains Quarterly* 4, no. 1 (Winter, 1984): 5-28.

of fancy. Yet, one must consider that in assessing the accuracy of a map, an individual would likely use the truths that inspired them and supported their worldview.[74]

The images and dreams that swam in Jefferson's mind formed the source material for constructing the goals and route of the Lewis and Clark Expedition.[75] Jefferson represented the dual mandate embodied in two complementary visions of the West – the West as a garden capable of supporting an agricultural republic, and the West as supporting a lucrative trade empire through an easy water passage to the Pacific.[76] As Lewis and Clark were exploring the western landscape and assessing its agricultural potential, they were to keep a keen eye out for a practical river route to the Pacific.[77] Jefferson had amassed a large library of materials pertaining to the geography and nature of the West and had corresponded and conversed with scientists, geographers, and residents of the Louisiana Territory. He was familiar with the most important

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[74] For information on the constructed nature of maps, see Martin Brückner, *The Geographic Revolution in Early America: Maps, Literacy, and National Identity* (Chapel Hill, NC: University of North Carolina Press, 2006); D. Graham Burnett, *Masters of All They Surveyed: Exploration, Geography, and a British El Dorado* (Chicago: University of Chicago Press, 2000); Paul E. Cohen, *Mapping the West: America's Westward Movement 1524-1890* New York: Rizzoli, 2002.); Raymond B. Craib, *Cartographic Mexico: A History of State Fixations and Fugitive Landscapes* (Durham, NC: Duke University Press, 2004); J. B. Harley and Paul Laxton, *The New Nature of Maps: Essays in the History of Cartography* (Baltimore, MD: Johns Hopkins University Press, 2001); Christian Jacob and Edward H. Dahl, *The Sovereign Map: Theoretical Approaches in Cartography Throughout History* [in Translated from the French.]. English-language ed. (Chicago, IL: University of Chicago Press, 2006); Martin W. Lewis and Kären Wigen, *The Myth of Continents a Critique of Metageography* (Berkeley, CA: University of California Press, 1997); David N. Livingstone, *The Geographical Tradition: Episodes in the History of a Contested Enterprise* (Cambridge, MA: Blackwell, 1993); Susan Schulten, *The Geographical Imagination in America, 1880-1950* (Chicago: University of Chicago Press, 2001); Susan Schulten, *Mapping the Nation: History and Cartography in Nineteenth-Century America* (Chicago: University of Chicago Press, 2012); Yi-Fu Tuan, *Space and Place: The Perspective of Experience* (Minneapolis, MN: University of Minnesota Press, 1977); Yi-Fu Tuan, *Topophilia: A Study of Environmental Perception, Attitudes, and Values* (New York: Columbia University Press, 1990); and Yi-Fu Tuan, "Images and Mental Maps," *Annals of the Association of American Geographers* 65, no. 2 (1975): 205-213.

[75] Historical geographer John Logan Allen has assigned the greater part of the vision that drove the Lewis and Clark Expedition to Thomas Jefferson, the "most knowledgeable American insofar as the geographical lore of the trans-Mississippi region was concerned."; (Allen, *Lewis and Clark and the Image*, 61).

[76] Smith, *Virgin Land*, 13; Allen, *Lewis and Clark and the Image*, 60.

[77] Allen, *Lewis and Clark and the Image*, 60.

cartographic visionaries of his day.[78] Jefferson's infatuation with the geographical lore of the West as a garden possessing a navigable passage to the riches of the Orient surely colored his interpretation of this available information.

Gallatin and Jefferson were not only interested in the watery passage to India. They were also attentive to the settlement future of the United States. To become an agricultural republic, the country needed adequate supplies of water to support the multitude of citizens that would soon inundate the western landscape. They therefore ordered Lewis and Clark to catalogue all of the drainages of the Missouri and to observe the fertility of the land, its natural resources, and its climatic characteristics.[79] The exploration of Louisiana Territory by Lewis and Clark was what has become known to historians of science as a Humboldtian expedition. The Prussian aristocrat, explorer, and naturalist Alexander von Humboldt was *the* scientific celebrity of the nineteenth century who virtually all men of science sought to emulate.[80] The famous scientist's knowledge of the West was even sought by Jefferson during Humboldt's visit to Washington.[81] In writing the classic *Cosmos*, Humboldt proclaimed his "principal impulse . . . was the earnest endeavor to comprehend the phenomena of physical objects in their general connection, and to represent nature as one great whole, moved and animated by internal

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[78] For example, he was likely familiar with Daniel Coxe, Baron Lahontan, Robert Rogers, Jonathan Carver, Carlevoix, Du Pratz, and perhaps most importantly Alexander MacKenzie.; See Allen, *Lewis and Clark and the Image*, 63.
[79] Allen, *Lewis and Clark and the Image*, 104, 108.
[80] For other studies of Humboldt's influence, see: Mary Louise Pratt, *Imperial Eyes: Travel Writing and Transculturation* (New York: Routledge, 1992); Aaron Sachs, *The Humboldt Current: Nineteenth-Century Exploration and the Roots of American Environmentalism* (New York: Viking, 2006); Laura Dassow Walls, *The Passage to Cosmos: Alexander Von Humboldt and the Shaping of America* (Chicago: University of Chicago Press, 2009).
[81] Sachs, *The Humboldt Current*, 3-5.

forces."[82] Humboldt's holistic approach sought to capture the interconnections of all natural phenomena. He was also concerned with social justice and the human place in nature. Humboldtian science represented a transition from natural philosophy to a restructured and holistic natural science.[83] During this transition, American scientific men adopted his methodological approach and blended it with the Baconianism necessary for collecting data in the extreme expanses of the U.S. territory. These visions laid the foundation for the execution of early explorations into the North American interior.[84] But, in the field Humboldtianism and Baconianism have limits since explorers are constrained by time and resources and they come to their subject with somewhat rigid expectations.

The western frontier was an overwhelmingly large place that required extensive reconnaissance to apprehend its worth to a growing American nation. The Louisiana Purchase was a bargain, but it brought with it the intimidating prospect of assessing the actual worth of the acquired lands [Figure 19]. Was the West the fabled garden and avenue to the Orient, or simply a barren and arid wasteland that might at best serve to fortify the western edge of the United States from foreign invaders? Expeditions into this vast territory had to observe everything and document the nature and environment of the

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[82] Alexander von Humboldt, E.C. Otté, B.H. Paul, and W.S. Dallas, *Cosmos: A Sketch of a Physical Description of the Universe* (New York: Harper & Brothers, 1850), vii.
[83] Michael Dettelbach, "Humboldtian Science," in *Cultures of Natural History*, edited by N. Jardine, J. A. Secord, and E. C. Spary (New York: Cambridge University Press, 1996), 287-304, on 304.
[84] Robert V. Bruce, *The Launching of Modern American Science, 1846-1876* (Ithaca, NY: Cornell University Press, 1987), 68-74; Susan Faye Cannon, *Science in Culture: The Early Victorian Period* (New York: Dawson; Science History Publications, 1978), 73-110.; William H. Goetzmann, *Army Exploration in the American West 1803-1863*, Yale Publications in American Studies (New Haven, CT: Yale University Press, 1959), 18.; For a rejection of the Baconian label applied to American scientists, see James Rodger Fleming, *Meteorology in America, 1800-1870* (Baltimore, MD: The Johns Hopkins University Press, 1990).

West. This was an impossible task. To help guide his men, Jefferson gave Lewis detailed instructions for their traverse across Louisiana Territory. Jefferson instructed Lewis to collect celestial observations, geographic data especially in regards to rivers, extensive ethnographic data concerning the Native Americans of the West, the condition of the soil, climate, weather, the flora and fauna both living and possibly extinct along with their seasonal patterns, volcanoes, and the minerals and metals including limestone, coal, salt petre, and mineral waters. Above all, however, this mission was to head up the Missouri and ascertain if there was a "direct & practicable water communication across this continent for the purposes of commerce."[85] Jefferson was also interested in confirming his belief that the West was a fertile garden ready for settlement.[86] Therefore, while this exploratory mission appeared to be Humboldtian, its attention to the varied detail of the frontier was circumscribed by expectations carried into the field.

Any rational explorer who sought to accomplish a set of objectives rather than wandering aimlessly would take time before an adventure to investigate the existing knowledge about the region. In the process of educating themselves, explorers unavoidably allowed the perceptions and dreams of others to filter into their framework for comprehending the continent.[87] By viewing maps and reading travel literature written by previous explorers, those setting out into unfamiliar regions brought with them a conceptual framework nestled within their cultural milieu through which they viewed the

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[85] Thomas Jefferson, "Transcript: Jefferson's Instructions for Meriwether Lewis" June 20, 1803. In "Thomas Jefferson and Early Western Explorers, Transcribed and Edited by Gerard W. Gawalt, Manuscript Division, Library of Congress." "Rivers, Edens, Empires: Lewis & Clark and the Revealing of America." Library of Congress, accessed May 27, 2014. http://www.loc.gov/exhibits/lewisandclark/transcript57.html; Allen, *Lewis and Clark and the Image*, 81.
[86] Allen, *Lewis and Clark and the Image*, 50-55; Smith, *Virgin Land*, 12-13.
[87] Allen, *Lewis and Clark and the Image*, 110.

lands.[88] *Terra incongita* was never really unknown—it became *terra excogitari*. Explorers came to unknown lands with a pallet of known colors with which to paint the landscape's canvas.[89] Armed with hopes forged from their cultural context, those who imagined the West reconfigured old visions into new assemblages. Especially pertinent to this analysis, the West was continuously being recast along a spectrum that categorized it as a garden or a desert.[90]

The writings of Lewis and Clark's expedition through the north-central Louisiana Territory reveal the tension between two competing images of the West represented in early French and British explorations – garden vs. desert.[91] Even though Lewis and Clark knew that both of these earlier visions were derived from previous explorations, they held the Jeffersonian hopes of a garden-West while also considering their expedition a pioneering assessment of the truth. On April 7, 1805, as the duo sat in the security of Fort Mandan in the west-central portion of what would later become the state of North

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[88] Pratt, *Imperial Eyes.*; John Logan Allen, "Geographical Knowledge & American Images of the Louisiana Territory," *The Western Historical Quarterly* 2, no. 2 (1971): 151-170.; It is also important to note that Native Americans provided a significant amount of cartographic knowledge regarding western rivers. For a study of how Native American knowledge was incorporated into Euro-American style maps, see: G. Malcolm Lewis, "Misinterpretation of Amerindian Information as a Source of Error on Euro-American Maps," *Annals of the Association of American Geographers* 77, no. 4 (1987): 542-563.

[89] William H. Goetzmann, *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West* (New York,: Knopf, 1966), xi.; D.W. Meinig, "The Beholding Eye: Ten Versions of the Same Scene," in D.W. Meinig, ed. *The Interpretation of Ordinary Landscapes* (New York: Oxford University Press, 1979), 34.; John Logan Allen, "New World Encounters: Exploring the Great Plains of North America," *Great Plains Quarterly* 13, no. 2 (1993): 69.

[90] John Logan Allen, "The Garden-Desert Continuum: Competing Views of the Great Plains in the Nineteenth Century," *Great Plains Quarterly* 5, no. 4 (1985): 207-220.

[91] Histories of the Lewis and Clark Expedition include: Stephen E. Ambrose, *Undaunted Courage: Meriwether Lewis, Thomas Jefferson, and the Opening of the American West* (New York: Simon & Schuster, 1997); Donald Jackson, *Thomas Jefferson & the Stony Mountains: Exploring the West from Monticello* (Norman, OK: University of Oklahoma Press, 1993); Lavender, *The Way to the Western Sea.*; James P. Ronda, *Jefferson's West: A Journey with Lewis and Clark* Monticello Monograph Series (Charlottesville, VA.: Thomas Jefferson Foundation, 2000); James P. Ronda, *Finding the West: Explorations with Lewis and Clark* (Albuquerque, NM: University of New Mexico Press, 2001); Ronda, *Lewis and Clark among the Indians.*; Stephanie Ambrose Tubbs and Clay Jenkinson, *The Lewis and Clark Companion: An Encyclopedic Guide to the Voyage of Discovery* (New York: Henry Holt, 2003).

Dakota, Lewis stated, "[w]e are now about to penetrate a country at least two thousand miles in width upon which the foot of civilized man has never trodden; the good or evil it had in store for us was for experiment yet to determine."[92] Regardless of the uncertainties, Lewis was healthy and hopeful. In a letter to Jefferson from Fort Mandan, Lewis stated that he saw "no material or probable obstruction to our progress and entertain, therefore, the most sanguine hopes of complete success…With such men I have everything to hope, and but little to fear."[93] Furthermore, the knowledge that they gathered from Native American sources indicated that the lands they would traverse were well-timbered and fertile.[94] Lewis believed that their western travels into the untrodden wilderness would yield useful knowledge that would confirm Jefferson's vision for the future of the American nation.

The journals of the Lewis and Clark Expedition reveal that the party primarily experienced the West as a garden. Before they embarked into the unknown lands of the northwest, for fear that the knowledge they had gathered might be lost, Lewis and Clark sent Jefferson the data that they had accumulated along the way to Fort Mandan. What they saw along their route challenged the prospect of an uninhabitable frontier. During their stay at Fort Mandan, Lewis wrote to his mother and spoke of the unparalleled

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[92] Meriwether Lewis, William Clark, et al., April 7, 1805 entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1804-1805.winter.introduction.xml&_xslsrc=LCstyles.xsl. For a compilation and edited volume of the letters from North Dakota, see: Meriwether Lewis, Clay Jenkinson, and James P. Ronda, *A Vast and Open Plain: The Writings of the Lewis and Clark Expedition in North Dakota, 1804-1806* (Bismarck, ND: State Historical Society of North Dakota, 2003).

[93] Meriwether Lewis and William Clark, *Travels to the Source of the Missouri River and Across the American Continent to the Pacific Ocean* (London: Longman, Hurst, Rees, Orme, and Brown, 1814), xii.

[94] Meriwether Lewis, William Clark, et. al., "Fort Mandan Miscellany, Part 1: Affluents of the Missouri River" entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1804-1805.winter.part1.xml&_xslsrc=LCstyles.xsl.

beauty of the Missouri River route.[95] He excitedly explained, "[t]his immence river so far as we have yet ascended, waters one of the fairest portions of the globe, nor do I believe that there is in the universe a similar extent of country equally fertile, well watered, and intersected by such a number of navigable streams."[96] Reporting back to Jefferson, Clark noted that there were fertile lands to be encountered along the route up to Fort Mandan and that "[t]he Climate thro which the Missouri passes is Certainly pleasing & desireable between the Latituds of 38° & 48° North."[97]

Within this large swath of land, the party encountered fertile lands that were already being settled by American emigrants. Descriptions that supported the garden West abounded in their report on the "Affluents of the Missouri River." The following phrases were used to label these lands: "fertile well timbered country," "thickly covered with timber and tolerably fertile," "fertile in the extreem," "the soil fertile in the extreme, and well covered with excellent timber."[98] The presence of valuable timber supplies suggested fertility. The pairing of these two elements is not surprising since Lewis and Clark were assessing the lands for their settlement potential, and both timber and arable soil were requirements to fulfill the yeoman farmer dream of Jefferson.[99] The duo thus looked at the West through eastern eyes and sought the pastoral pairing of tillable land

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[95] Lavender, *The Way to the Western Sea*, 181.
[96] Meriwether Lewis, Fort Mandan, 1609 miles above the entrance of the Missouri, March 31st 1805." In "Letters Home: Meriwether Lewis to His Mother," transcribed by Tim Grove, *Gateway Heritage* vol. 24, No. 2 &3, Fall 2003-Winter 2004." (http://collections.mohistory.org/media/CDM/gateway/105.pdf)
[97] Meriwether Lewis, William Clark, et. al., "Fort Mandan Miscellany, Part 5: Missouri River Miscellany" entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1804-1805.winter.part5.xml&_xslsrc=LCstyles.xsl.
[98] "Fort Mandan Miscellany, Part 1: Affluents of the Missouri River."
[99] This association between well-timbered and agriculturally fertile land persisted into the late nineteenth century when theories circulated that tree planting could restore the West's fertility.

and lush forests upon which the growing nation would thrive.[100] In their travels across the continent they did not find the Northwest Passage, but visions of the garden-West were fertilized by the findings of Lewis and Clark [Figures 20 and 21].

Louisiana Territory was a garden in Jefferson's mind. It could be nothing else. Early maps and the testimony of settlers seemed to justify his belief. Dispatching Lewis and Clark to the region would serve economic ends by establishing trade relationships with the Native Americans. Their explorations would also confirm his hopes for an agricultural Eden. This is likely due to the fact that Jefferson hand-picked and guided the training of these men. Lewis and Clark went into the West looking to confirm his vision. Regardless of the Humboldtian and Baconian character of their science, the nature of the West would reflect what they brought with them into the field.

The Desert-West Triumphant

Desires for a watered and fertile West did not save Lewis and Clark from the harsh arid reality of eastern Montana. By late May of 1805, the fertile landscape had almost entirely disappeared.[101] Nevertheless, their encounter with a parched landscape was transitory. For later explorers, however, it left a lasting impression. Through the writings of Lewis and Clark, Zebulon Montgomery Pike, and Stephen Harriman Long, this section will show the shifting western sentiments conveyed to the public by explorers and the fluidity of the West in the imagination. In the beginning of the nineteenth

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[100] Lavender, *The Way to the Western Sea*, 182.
[101] W. Eugene Hollon, *The Great American Desert Then and Now* (Lincoln, NE: University of Nebraska Press, 1975), 60-62.; For an examination of the weather experienced by the Expedition, see: Terry L. Alford, "The West as a Desert in American Thought Prior to 1820," *Journal of the West* 8 (1969): 518.; Karen Jean De Bres, "Exploration in a Continental Climate: Weather in the Central Plains Recorded in the Journal of William Clark," *Heritage of the Great Plains* 37, no. 1 (Spring/Summer 2004): 63-74.

century, the region underwent a complete revision in how it was understood. The frontier began as a garden, and by mid-century, explorers had utterly revised the western geography to reflect a "Great American Desert."[102]

In eastern Montana, the Lewis and Clark Expedition came face to face with what later explorers would call the "Great American Desert." Travelling through north-central Montana along the Missouri River, the journals of the expedition increasingly express dismay at the desert-like landscape. The entry for May 26, 1805 was particularly bleak. Lewis stated, "[t]his is truly a desert barren country and I feel myself still more convinced of it's being a continuation of the black hills." In a statement that foreshadowed the desert descriptions of the West that would follow, Clark lamented, "we had a few drops of rain at Dark.— the Salts Coal & Burnt hills & Pumicston Still Continue, game Scerce this Countrey may with propriety I think be termed the Deserts of America, as I do not Conceive any part can ever be Settled, as it is deficent in water, Timber & too Steep to be tilled."[103] Fellow expedition members Sergeant John Ordway and Sergeant Patrick Gass echoed these environmental perceptions. The following day, Lewis made note of the presence of coal and the continued "broken and barren" nature of the landscape. For

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[102] Wallace Stegner and others note that the life of the "Great American Desert" was enhanced by its linguistic flexibility and varied meaning. For example, he stated, "[t]he poetic and romantic meaning of 'desert' was one thing, the popular meaning another. According to the one, any unpeopled wilderness, especially open grasslands but even dense woods, could be called a desert. According to the other, a desert must be a waste of naked sand and rock. Confusion between the two terms partly explains both the growth of the belief in the Great American Desert's existence, and its denial."; (Wallace Stegner, *Beyond the Hundredth Meridian: John Wesley Powell and the Second Opening of the West* (New York: Penguin Books, 1992), 215.; See also: James C. Malin, *The Grassland of North America: Prolegomena to its History* (Ann Arbor, MI: Edwards Brothers, Inc., 1947), 82-83.; Kevin Z. Sweeney, "Wither the Fruited Plain: The Long Expedition and the Description of the 'Great American Desert'," *Great Plains Quarterly* 25, no. 2 (2005):114-115.)

[103] Meriwether Lewis, William Clark, et. al., May 26, 1805 entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1805-05-26.xml&_xslsrc=LCstyles.xsl.

Gass, the stark nature of this desert region prompted him to assess the future prospects of the land they had thus far encountered because he saw no "encouraging prospects" that the "scenes of barrenness and desolation" would "terminate."[104] The aridity of this region struck at the heart of the hopes of the Expedition and troubled the men whose experiences might well determine the fate of Jefferson's dreams of an agricultural Eden.

Scholars such as James P. Ronda suggest that these perceptions were simply a reflection of seeing "western landscapes through eastern eyes and with sensibilities conditioned by eastern contours and colors."[105] But if so, their eastern eyes soon adjusted to this landscape that dominated their descriptions for two days. Their faith in the fertility of the West was not entirely dashed by their dramatic encounter with the "Deserts of America." Only a day after their two-day dismal float through the western desert, their dismay diminished and what their eyes saw enlivened their dreams. Lewis stated, "here also the river spreads to more than 3 times it's former width and is filled with a number of small and handsome Islands covered with cottonwood some timber also in the bottoms, the land again fertile. These appearances were quite reviving after the drairy country through which we had been passing."[106] In truth, contemporary studies suggest that the region they were traveling through had actually been experiencing a period of above average rainfall. Ultimately, this helped to strengthen their faith in the fruitful

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[104] Meriwether Lewis, William Clark, et al., May 27, 1805 entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1805-05-27.xml&_xslsrc=LCstyles.xsl#n14052711.

[105] James P. Ronda, "Counting Cats in Zanzibar, or, Lewis and Clark Reconsidered," *The Western Historical Quarterly* 33, no. 1 (2002): 13.

[106] Meriwether Lewis, William Clark, et al., May 28, 1805 entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1805-05-28.xml&_xslsrc=LCstyles.xsl.

future of American agricultural expansion.[107] The Expedition had escaped the deserts that to Gass seemed unending. Henceforth, references in their journals to arid and sterile landscapes were overwhelmingly outweighed by those describing fertile lands.

Still, many of the ambitious goals that were set forth by Jefferson would not stand up to the realities of penetrating the North American continent. In the end, the significance of the expedition was its profound impact on the public's imagination that deepened the popular faith in the young nation's future. [108] It revealed the firm reality of a path across the continent and documented the vast expanses and natural resources that awaited the adventurous.[109] It set the stage for a western drama that dominated the first half of the nineteenth century as more explorers, fur traders, argonauts, and migrants made their way to the frontier, and eventually helped to establish lasting settlements and overland trails worn by wagon wheels and paved with dreams of a better life.[110]

The expeditions that followed Lewis and Clark into the West began to fill in the cartographic gaps left by their limited traverse across the continent. Some of these men were fur trappers who exploited a coveted consumer item – beaver pelts. As a consequence of their ambitions for wealth they acquired environmental knowledge that was used by official government scientists and surveyors. Military men like Zebulon Montgomery Pike and Stephen Harriman Long also assessed the land using Humboldtian and Baconian methods in an effort to learn of the utility of western lands. Their less-than-

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[107] Sweeney, "Wither the Fruited Plain,"111.; Marc Reisner, *Cadillac Desert: The American West and Its Disappearing Water* (New York: Penguin Books, 1993), 18-19.
[108] Ronda, "Counting Cats in Zanzibar", 18.; James P. Hendrix, Jr., "A New Vision of America: Lewis and Clark and the Emergence of the American Imagination," *Great Plains Quarterly* 21, no. 3 (2001): 211-232.
[109] Smith, *Virgin Land*, 18; Goetzmann, *Exploration and Empire*, 3-4.
[110] William H. Goetzmann, *New Lands, New Men: America and the Second Great Age of Discovery* (New York: Penguin Books, 1987), 115.

favorable conclusions suggested that the West was primarily useful as a bulwark against invasion or a barrier to settlement and expansion. The vast West was no longer a Garden or an easy passage to India; it was the "Great American Desert."

Pike began exploring Louisiana Territory contemporaneous with Lewis and Clark.[111] While Jefferson did not initiate Pike's expedition into the region, the President did approve of his explorations *ex post facto* because it contributed to his aims of extending the American empire and filling in the nation's map.[112] Pike used a map stolen from Humboldt during his visit with Jefferson to construct his own cartographic vision of the West.[113] Upon his return, Pike's motives and those of his duplicitous superior and spy for Spain, General James A. Wilkinson (also known as Agent 13 by his Spanish handlers), have ever since been shrouded in intrigue and pursued by historians.[114] Recently, historians reassessing the legacy of Pike have stated plainly that there is not enough evidence to either exonerate or condemn him for his role in Wilkinson's improprieties.[115] Regardless of Pike's perceived ineptitude as a "lost pathfinder" or role in attempting to secure sections of Louisiana Territory for the seditious Aaron Burr, his less-than-favorable vision of the West painted a dreary desert on the mental maps of the American public.

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[111] For biographical information concerning the life of Zebulon Pike, see: Matthew L. Harris and Jay H. Buckley, *Zebulon Pike, Thomas Jefferson, and the Opening of the American West* (Norman, OK: University of Oklahoma Press, 2012); Jared Orsi, *Citizen Explorer: The Life of Zebulon Pike* (New York: Oxford University Press, 2014); W. Eugene Hollon, *The Lost Pathfinder, Zebulon Montgomery Pike* (Norman, OK: University of Oklahoma Press, 1949); John Upton Terrell, *Zebulon Pike: The Life and Times of an Adventurer* (New York: Weybright and Talley, 1968).
[112] Hollon, *The Lost Pathfinder*, 53; James P. Ronda, "Pike and Empire," in Harris and Buckley eds., *Zebulon Pike, Thomas Jefferson, and the Opening of the American West*, 62, 64, 78.
[113] Hollon, *The Lost Pathfinder*, 177; Terrell, *Zebulon Pike*, 223; Goetzmann, *New Lands, New Men*, 119.
[114] Matthew L. Harris, "Introduction: Zebulon Montgomery Pike in American Memory," in Harris and Buckley eds., *Zebulon Pike, Thomas Jefferson, and the Opening of the American West*, 6.
[115] Matthew L. Harris, "Introduction: Zebulon Montgomery Pike in American Memory," in Harris and Buckley eds., *Zebulon Pike, Thomas Jefferson, and the Opening of the American West*, 12.

Oddly enough, what has fed the fires of conspiracy is the fact that Pike's perceptions of the central Great Plains recorded in his journals were generally favorable during his 1806-07 expedition into Louisiana Territory and New Spain.[116] It was only 3 years later when writing his *Dissertation on Louisiana* that Pike's vision of the West dried up. For example, during Pike's travels through Missouri, Kansas, and Colorado his journals were full of references to prairies and even places where "Nature scarcely ever formed a more beautiful place for a farm."[117] His mind overflowed with ocean metaphors to describe the prairie landscape. Looking down from heights in Colorado he stated, "[t]he unbounded prairie was overhung with clouds, which appeared like the ocean in a storm, wave piled on wave and foaming."[118] Continuing his journey through Colorado, he stood upon a hilltop and viewed, "the sublime and the beautiful. The great and lofty mountains, covered with eternal snows, seemed to surround the luxuriant vale, crowned with perennial flowers, like a terrestrial paradise shut out from the view of man."[119] For a man well-known for his pessimism regarding the plains, Pike seemed to appreciate their raw beauty and future utility.

The pessimistic Pike emerges largely from his *Dissertation on Louisiana*. The beginning of this publication celebrated the settlement potential of the segment of the Louisiana Territory that lay before the Osage River in western Missouri. This region was well-timbered, he observed, had an abundance of coal and possessed fertile soils. Pike's

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[116] For the most recent edited volumes of Zebulon Pike's writings, see: Zebulon Montgomery Pike and Donald Jackson, *The Journals of Zebulon Montgomery Pike, with Letters and Related Documents*, 1st ed., 2 vols., American Exploration and Travel Series. (Norman, OK: University of Oklahoma Press, 1966).
[117] Zebulon M. Pike and Elliott Coues, *The Expeditions of Zebulon Montgomery Pike: To Headwaters of the Mississippi River, through Louisiana Territory, and in New Spain, During the Years 1805-6-7,* Vol. 2 (Francis P. Harper, 1895), 395.
[118] Pike and Coues, *The Expeditions of Zebulon Montgomery Pike* Vol. 2, 458.
[119] Pike and Coues, *The Expeditions of Zebulon Montgomery Pike* Vol. 2, 497.

inner booster and plains prophet shines through when speaking of the "country round the Osage villages." He believed this country to be "one of the most beautiful the eye ever beheld." Taken hold by the scenery, Pike then elaborated a passionate proclamation that,

> giving the advantages of wood and water, and at the same time the extensive prairies crowned with rich and luxuriant grass and flowers, gently diversified by the rising swells and sloping lawns, present to the warm imagination the future seats of husbandry, the numerous herds of domestic animals, which are no doubt destined to crown with joy those happy plains.[120]

However, this pastoral paradise, according to Pike, terminated at the head of the Osage River. Further upstream, the Kansas, Platte, and Arkansas Rivers would only support "a limited population on their banks."[121] In this country that was almost devoid of timber, the primary mode of life would be ranching and only with the "discovery of coal-mines" would the country be "habitable."[122] The bright side to this, as it pertained to the Arkansas River, was that due to its abundance of game that could "feed all the savages in the United States territory one century," this part of the country could "be termed the terrestrial paradise of our territories for the wandering savages."[123]

What followed in Pike's prose could only be described as jettisoning Jefferson's garden-West in favor of a dream-destroying desert. Pike began by admitting that "naturalists" and "scientific characters" had already hypothesized reasons for the "vast tract of untimbered country which lies between the waters of the Missouri, Mississippi, and the Western Ocean, from the mouth of the latter river to 48^{o} north latitude."

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[120] Pike and Coues, *The Expeditions of Zebulon Montgomery Pike* Vol. 2, 514.
[121] Pike and Coues, *The Expeditions of Zebulon Montgomery Pike* Vol. 2, 523.
[122] Pike and Coues, *The Expeditions of Zebulon Montgomery Pike* Vol. 2, 523.
[123] Pike and Coues, *The Expeditions of Zebulon Montgomery Pike* Vol. 2, 522.

Nevertheless, he felt an earnest duty to describe "those internal deserts."[124] This was where his optimism ended. Pike reached back in time to assure his reader "that this country never was timbered; as, from the earliest age the aridity of the soil, having so few water-courses running through it, and they being principally dry in summer, has never afforded moisture sufficient to support the growth of timber."[125] Like later explorers, scientists, and boosters, Pike was using past environments to forecast the potential future of the region. He believed that the region always was, and therefore always would be, arid and consequently devoid of an essential ingredient of civilization – trees. "These vast plains of the western hemisphere," Pike pronounced, "may become in time as celebrated as the sandy deserts of Africa; for I saw in my route, in various places, tracts of many leagues where the wind had thrown up the sand in all the fanciful form of the ocean's rolling wave, and on which not a speck of vegetable matter existed."[126]

While he was trouncing on the firmly held belief of the Edenic western gardenscape, he was sure to extoll the virtues of a desertscape in the American interior. The area would not only be "celebrated" "in time," but:

> from these immense prairies may arise one great advantage to the United States, viz.: The restriction of our population to some certain limits, and thereby a continuation of the Union. Our citizens being so prone to rambling and extending themselves on the frontiers will, through necessity, be constrained to limit their extent on the west to the borders of the Missouri and the Mississippi, while they leave the prairies incapable of cultivation to the wandering and uncivilized aborigines of the country.[127]

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[124] Pike and Coues, *The Expeditions of Zebulon Montgomery Pike* Vol. 2, 524.
[125] Pike and Coues, *The Expeditions of Zebulon Montgomery Pike* Vol. 2, 524.
[126] Pike and Coues, *The Expeditions of Zebulon Montgomery Pike* Vol. 2, 525.
[127] Pike and Coues, *The Expeditions of Zebulon Montgomery Pike* Vol. 2, 525.

The West would be a bulwark against excessive expansion while also providing a realm for the ever-"wandering and uncivilized" Native Americans [Figure 22].

Pike's perception of the West described in his *Dissertation on Louisiana* has caught the attention of scholars for two reasons. The first is related to his connection to the Wilkinson-Burr conspiracy to usurp a portion of Louisiana Territory. The second is Pike's contribution to the powerful vision of the West as a desert that dominated American's geographic imaginations until at least the middle of the nineteenth century. Pike's involvement in the Wilkinson-Burr conspiracy is, as stated above, hotly debated.[128] However, it has been suggested that his unfavorable reports of Louisiana Territory were suspiciously useful for discouraging settlement and providing space for Wilkinson and Burr to execute their land grab.[129] It could have also served to paint the lands explored by Pike as useless and therefore unlikely to be coveted by Wilkinson and Burr.[130] Was Pike a "climate spy" and his *Dissertation on Louisiana* an effort to cook the books and libel the western environment? We will perhaps never really know. However, this theory is suggestive of the power of one man's vision to manipulate the malleable West.[131]

Pike's desert-West writings made it to press four years before those from the Lewis and Clark Expedition and consequently caught the attention of the public before

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[128] For more information on Pike and the Wilkinson-Burr conspiracy, see: W. Eugene Hollon, "Zebulon Montgomery Pike and the Wilkinson-Burr Conspiracy," *Proceedings of the American Philosophical Society* 91, no. 5 (1947): 447-456.
[129] John Logan Allen, "Pike and American Science," in Harris and Buckley eds., *Zebulon Pike, Thomas Jefferson, and the Opening of the American West*, 94.
[130] Merlin P. Lawson, Randy Cerveny, and Cary Mock, "Zebulon Pike: Great American Explorer or Climate Spy?," *Weatherwise* 63, no. 1 (2010): 30-31.
[131] By expressing its static nature as a desert land, he may have been taking advantage of the West's malleable qualities in terms of how the region was imagined. Just like the garden-West, the desert-West had its uses in forecasting the future.

the duo's support for the Jefferson-inspired garden-West.[132] Historians have since credited Pike's environmental assessment with helping to establish the first significant contribution to the belief in the "Great American Desert" that would occupy American minds until after the Civil War.[133] However, Pike was not alone in this Herculean effort of overturning the garden-West.[134] Ten years after the publication of Pike's western vision, Major Stephen Harriman Long cemented the desert-West in a map with the words "Great American Desert" emblazoned on the west-central plains [Figures 23 and 24].

Long was an officer in the Corps of Topographical Engineers, an arm of the Federal Government central to the early exploration of the American West prior to the Civil War.[135] He has been described as an "outstanding engineer" whose expertise was lent to steam engine technology, topographical methods, bridge-building, and improving boat technology for river navigation.[136] He was so well regarded that by mid-century, Long had achieved the position of superintendent of Western rivers, and was soon named the chief of the Topographical Engineers, a post he held until his 1863 retirement.[137] It has even been suggested in a recent biography that without his prodding, the Federal

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[132] Hollon, *The Lost Pathfinder*, 64.
[133] Jay H. Buckley, "Pike as Forgotten and Misunderstood Explorer," in Harris and Buckley eds., *Zebulon Pike, Thomas Jefferson, and the Opening of the American West*, 43.; Allen, "Pike and American Science," in Harris and Buckley eds., *Zebulon Pike, Thomas Jefferson, and the Opening of the American West*, 87, 94, 96.; Terrell, *Zebulon Pike*, 136.
[134] Alford, "The West as a Desert in American Thought Prior to 1820," 515-525.
[135] Richard A. Bartlett, *Great Surveys of the American West* (Norman, OK: University of Oklahoma Press, 1962), 333-334.; Richard George Wood, *Stephen Harriman Long, 1784-1864: Army Engineer, Explorer, Inventor* (Glendale, CA: A. H. Clark, 1966), 143-144, 171-172.; Goetzmann, *Army Exploration*, 4-21.
[136] Wood, *Stephen Harriman Long*, 11-12.
[137] Maxine Benson, *From Pittsburgh to the Rocky Mountains: Major Stephen Long's Expedition, 1819-1820* (Golden, CO: Fulcrum, 1988), xxi.; Wood, *Stephen Harriman Long*, 253-263.

Government would have neglected scientific exploration of the West for two more decades.[138]

Long's 1819-1820 Expedition to the West, also known as the Yellowstone Expedition or the Missouri Expedition, was in essence an imperial project derived from the plans of secretary of war John C. Calhoun who intended to flex America's military might.[139] For two reasons it was also something much more, though the first reason has long-since overshadowed the second. Long's contribution to the idea of the desert-West has served to eclipse the expedition's considerable scientific merit.[140] Long used the instructions Jefferson gave to Lewis, and his men returned with a significant amount of scientific information pertaining to flora and fauna, climate, geology, paleontology, ethnography, and navigation.[141] The information was published in scientific periodicals, resonated through lyceums, and was put into the hands of eager eastern men of science.[142] Charles Willson Peale's Philadelphia Museum, which housed the *American Incognitum* (discussed in Chapter 4) and many specimens from the Lewis and Clark Expedition, served as the final resting place of many of the Long Expedition's specimens. At Peale's Museum, they entertained the curious and fueled the minds of interested men of science helping to fill American minds with images of the West.[143] Long's Expedition

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[138] Nichols and Halley, *Stephen Long and American Frontier Exploration*, 17.
[139] Benson, *From Pittsburgh to the Rocky Mountains*, iii.
[140] Benson, *From Pittsburgh to the Rocky Mountains*, xvi-xvii.
[141] Howard Ensign Evans, *The Natural History of the Long Expedition to the Rocky Mountains, 1819-1820* (New York: Oxford University Press, 1997).
[142] Nichols and Halley, *Stephen Long and American Frontier Exploration*, 18, 172-180.
[143] Richard G. Beidleman, "The 1820 Long Expedition," *American Zoologist* 26, no. 2 (1986): 313.; Richard H. Dillon, "Stephen Long's Great American Desert," *Proceedings of the American Philosophical Society* 111, no. 2 (1967): 94.; Goetzmann, *Exploration and Empire*, 59.; Goetzmann, *New Lands, New Men*, 124; Carlo Rotella, "Travels in a Subjective West: The Letters of Edwin James and Major Stephen

began the process of explorers and scientists amassing evidence in support of a malleable West. It is likely due to the expedition's scientific value that the Great American Desert concept gained so much traction and has since tainted Long's legacy.

Even if the Long Expedition was a scientific success, many historians have come to regard Long as *the* progenitor of the desert-West in the American mind. As we have seen above, this is simply untrue.[144] Nevertheless, historians use terms such as "legend" and "myth" to describe Long's labeling large sections of the West as parched desert landscapes.[145] Western historians Ray Allen Billington and Martin Ridge go as far as to refer to the expedition as "Long's fiasco" because he "not only failed to unlock the secrets of the Far West; he nurtured a myth that denied what most frontier people believed, that the West was a fertile garden."[146] Long has also been criticized as a lack-luster scientist out for personal gain, and as a vengeful explorer who generated a negative report in order to undermine Congress for cutting his appropriations.[147] One historian noted that Lewis and Clark were far more "careful" and "talented explorers and cartographers" than those like Long who had perpetuated the "myth" of the Great American Desert.[148] But, perhaps, as other historians have observed, the Long Expedition

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Long's Scientific Expedition of 1819-1820," *Montana: The Magazine of Western History* 41, no. 4 (1991): 24.

[144] Stegner, *Beyond the Hundredth Meridian*, 215.; Rotella, "Travels in a Subjective West," 24, 26.

[145] Wood, *Stephen Harriman Long*, 116, 119.; Dillon, "Stephen Long's Great American Desert," 93.; Goetzmann, *Army Exploration*, 43.

[146] Ray Allen Billington and Martin Ridge, *Westward Expansion: A History of the American Frontier*, 6th ed. (Albuquerque, NM: University of New Mexico Press, 2001), 92.

[147] Rotella, "Travels in a Subjective West," 24, 26; Cardinal Goodwin, "A Larger View of the Yellowstone Expedition, 1819-1820," *The Mississippi Valley Historical Review* 4, no. 3 (1917): 309.; Benson, *From Pittsburgh to the Rocky Mountains*, vii.; Goetzmann, *Army Exploration*, 41-42.; Beidleman, "The 1820 Long Expedition," 307, 312.

[148] Dillon, "Stephen Long's Great American Desert," 93.

in fact "initiated more professional scientific mapping and analysis of the West."[149] Even with a limited budget, it was the first true scientific expedition to observe the West.[150] The hurried nature of the expedition did yield negative views of the West from Long and his party, but it is also evident that their observations on the arid character of the West held substantial truth.[151]

Long and his company also came to the West with eastern eyes in the heat of the summer during a period of drought.[152] The sight of a landscape devoid of trees made the men feel as if they were in an alien land. Like Lewis and Clark, to Long and his company forests meant fertility, life, and agriculture.[153] The West beyond the one hundredth meridian would have been foreign to any intrepid eastern explorer used to lush lands and forests full of deciduous foliage.[154] Drought further intensified the nature of the West during the expeditions of Pike and Long.[155] It is likely that Long was accurately assessing the character of the harsh geography. In fact, some historians have suggested that the Dust Bowl of the 1930s vindicated Long's vision.[156] The West indeed had limits for agricultural exploitation.

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[149] Goetzmann, *New Lands, New Men*, 126.
[150] Beidleman, "The 1820 Long Expedition," 307, 313.
[151] Rotella, "Travels in a Subjective West," 26.
[152] Beidleman, "The 1820 Long Expedition," 312.; Sweeney, "Wither the Fruited Plain," 107-108.; E. R. Cook and P. J. Krusic. 2004. The North American Drought Atlas. Lamont-Doherty Earth Observatory and the National Science Foundation. http://iridl.ldeo.columbia.edu/SOURCES/.LDEO/.TRL/.NADA2004/.pdsi-atlas.html.
[153] Reisner, *Cadillac Desert*, 18-19.; Dillon, "Stephen Long's Great American Desert," 102.
[154] Wallace Stegner, *The American West as Living Space* (Ann Arbor, MI: University of Michigan Press, 1987), 6.; Stegner, *Beyond the Hundredth Meridian*, 214.; Walter Prescott Webb, "The American West: Perpetual Mirage," *Harper's Magazine* (1957).; Walter Prescott Webb, "The West and the Desert," *Montana: The Magazine of Western History* 8, no. 1 (1958).; Walter Prescott Webb, *The Great Plains* (Boston, MA: Ginn, 1959). 486-491.
[155] Sweeney, "Wither the Fruited Plain."
[156] Goetzmann, *Army Exploration*, 43.; Goetzmann, *New Lands, New Men*, 124, 126.; Dillon, "Stephen Long's Great American Desert," 108.; Benson, *From Pittsburgh to the Rocky Mountains*, xv.

Regardless, there is little doubt that Long's prose undermined the prophesy of a garden: his West was arid and hostile to American life. The region, according to Long, was "an extent of more than four hundred miles square, lying between ninety-six and one hundred and six degrees of west longitude, and between thirty-five and forty-two degrees of north latitude."[157] In his "General Description of the Country Traversed by the Exploring Expedition," Long proclaimed disparagingly:

> In regard to this extensive section of the country, we do not hesitate in giving the opinion, that it is almost wholly unfit for cultivation, and of course uninhabitable by a people depending upon agriculture for their subsistence. Although tracts of fertile land, considerably extensive, are occasionally to be met with, yet the scarcity of wood and water, almost uniformly prevalent, will prove an insuperable obstacle in the way of settling the country…This region, however, viewed as a frontier, may prove of infinite importance to the United States, inasmuch as it is calculated to serve as a barrier to prevent too great an extension of our population westward, and secure us against the machinations or incursions of an enemy, that might otherwise be disposed to annoy us in that quarter.[158]

Long's description was not limited to the 400 square mile region he outlined above, but he called upon the reports of Lewis and Clark to extend his assessment northward. Like Pike's view of the West, Long regarded the area as a convenient barrier suited only for the wild creatures and wilder peoples of the continent.

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[157] Edwin James, *Account of an Expedition from Pittsburgh to the Rocky Mountains, Performed in the Years 1819 and '20, by Order of the Hon. J. C. Calhoun, Sec'y of War under the Command of Major Stephen H. Long: From the Notes of Major Long, Mr. T. Say and Other Gentlemen of the Exploring Party* Vol. 2 (Philadelphia, PA: H.C. Carey and I. Lea, 1823), 350.

[158] Stephen H. Long, "A General Description of the Country Traversed by the Exploring Expedition: Being the Copy of a Report of Major Long to the Hon. J. C. Calhoun, Secretary of War, Dated Philadelphia, Jan. 20. 1821," in Reuben Gold Thwaites ed., *Early Western Travels,* Vol. XVII (Cleveland, OH: The Arthur H. Clark Company, 1905), 147-148.; James, *Account of an Expedition from Pittsburgh to the Rocky Mountains,* Vol. 2, 361.

Long also had reason to be less optimistic than those that followed him after the Civil War. Although he has since received a lot of negative press due to his apparent lack of foresight, he was a man of his times and had assessed the West with the tools he had at his disposal.[159] Long could not know of the coming wonders of fossil-fueled technologies and good press that would once again highlight the land's plasticity. One of Long's biographies, written during the Cold War, a time of intense technofaith, contained a preface by the Chief of Engineers who assured his readers that Long could not be blamed for his inability to predict the future. Long simply was viewing the "dry and desolate areas in terms of the land requirements and limits on engineering capability of his day."[160] The Chief of Engineers argued that "[t]he techniques which have since enabled the Corps of Engineers and the Bureau of Reclamation to build the great water resource conservation projects which brought life to that area, neither existed then nor were necessary."[161] Edwin James, the expedition's botanist, geologist, and the man who penned the published account of Long's expedition, had shared Long's views of the desert-West and as a result was not immune to this type of criticism. One historian went as far to note that the dry-farming and irrigation techniques applied to the West sixty years later "would mock his prophesy."[162] This is a common anachronistic refrain from those analyzing Long's legacy in retrospect, and one that is perhaps more indicative of their own modern faith in science and technology than any fair judgment of Long's

[159] Goetzmann, *Army Exploration*, 44.
[160] Wood, *Stephen Harriman Long*, 12.
[161] Wood, *Stephen Harriman Long*, 12-13.
[162] Dillon, "Stephen Long's Great American Desert," 102.

conclusion.[163] The West would eventually be conquered through technology, overturning the desert visions in favor of the garden-West.[164] As will be covered in Chapter 8, technology became the preferred mechanism to reclaim the desert.

Along with being an engineer, Long was an able cartographer. His critical description of the agricultural potential of the Great Plains did not overshadow his accomplishments in this arena. While not all contemporary critics agreed, Long had produced a well-constructed map that was often copied to produce future representations of the West.[165] Through his successful cartographic contribution, he became the point-source for the popularization of the Great American Desert.[166] Historians have argued that Long's effect on the public was so profound he essentially defined how people thought about the West for half a century, effectively limiting future western exploration.[167]

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[163] Goetzmann, *Army Exploration*, 45.; Goetzmann, *New Lands, New Men*, 126.; Hollon, *The Great American Desert*, 62-64.; Rotella, "Travels in a Subjective West," 26.; Reuben Gold Thwaites, *Early Western Travels, 1748-1846; a Series of Annotated Reprints of Some of the Best and Rarest Contemporary Volumes of Travel, Descriptive of the Aborigines and Social and Economic Conditions in the Middle and Far West, During the Period of Early American Settlement*, 32 Vols., Vol. XIV (Cleveland, OH: Arthur H. Clark Company, 1905), 20-22.; Wood, *Stephen Harriman Long*, 117-118.; However, historians regularly ignore the impact of the increasing use of fossil fuel energy as an essential element in enabling the industrial East to invade the West.

[164] For the most famous example of a historical analysis of the role of specific technologies in enabling western settlement, see: Webb, *The Great Plains.*

[165] Benson, *From Pittsburgh to the Rocky Mountains*, xiii, xvii.; Rotella, "Travels in a Subjective West," 24.; Wood, *Stephen Harriman Long*, 118.; Nichols and Halley, *Stephen Long and American Frontier Exploration*, 176-177.; Goetzmann, *New Lands, New Men*, 122.

[166] In his characteristically rich writing-style, Wallace Stegner described Long's impact: "[Long's] observations were borrowed by popular magazines and popular historians. By the mid-thirties the Great American Desert was firmly established on the maps and in the American mind, and it continued to be acknowledged for more than a generation."; (Stegner, *Beyond the Hundredth Meridian*, 215).

[167] Benson, *From Pittsburgh to the Rocky Mountains*, xiv-xv, xix.; Dillon, "Stephen Long's Great American Desert," 93, 94, 104.; Hollon, *The Great American Desert*, 7.; Goetzmann, *Army Exploration*, 119, 121.; Reisner, *Cadillac Desert*, 19.; Sweeney, "Wither the Fruited Plain," 105, 114.; Wood, *Stephen Harriman Long*, 116.; Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West* (New York: Pantheon Books, 1987), 68-69.; Smith, *Virgin Land*, 201-213.; Nichols and Halley, *Stephen Long and American Frontier Exploration*, 166-170, 177-178.

However, as historian Martyn J. Bowden revealed, the traditional story of this vision's universality is in reality far more complicated. The Great American Desert held captive imaginations primarily among the educated in the Northeast. Yet for those actually on the frontier, the desert-West was not a realistic or persuasive vision. The "common man" who sat on the fringe held a more pragmatic view. This is not to say that the image of the Great American Desert did not possess momentum into the post-Civil War decades. As will be discussed in Chapter 7, Bowden admitted that the desert persisted into the 1870s when the railroads, scientists, and boosters used it to demonstrate the transformative success story of western settlement.[168] Even if the Great American Desert did not infiltrate the minds of the "folk" along the frontier , the desert-West had resonated through American society and was powerful enough for propagandistic purposes. The hard fact that large regions of the West were arid could not be ignored.

Filtering through American society, the Pike and Long reports bolstered easterners', especially New Englanders', opposition to westward expansion. These were men of power, wealth, and influence, under whom the West would later become a colony of the East. In the early-to-mid nineteenth century, many easterners believed that there was value in keeping the Union from expanding too rapidly and thus allowing the nation's population to stretch too thinly across the broad canvas of the continent.[169] If citizens of the United States should not immigrate to this barren waste, however, the

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[168] Martyn J. Bowden, "The Great American Desert and the American Frontier, 1800-1882: Popular Images of the Plains," in *Anonymous Americans; Explorations in Nineteenth-Century Social History*, ed. Tamara K. Hareven (Englewood Cliffs, NJ: Prentice-Hall, 1971), 58, 68.

[169] Dillon, "Stephen Long's Great American Desert," 93.; Goetzmann, *Army Exploration*, 43-44.; Stegner, *Beyond the Hundredth Meridian*, 215.; Sweeney, "Wither the Fruited Plain," 107; Thwaites, *Early Western Travels*,Vol. XIV, 21.

region did offer a solution to the vexing problem of government policy towards Native Americans. A number of western historians have suggested that the belief in a desert-West lent support to the much-debated Indian Removal Act of 1830. The semi-arable lands just to the east of the Great American Desert could be given to the Native Americans of the East, while the Great American Desert itself would be the domain of the roaming Plains Tribes.[170] It is a telling coincidence that as the desert-West began to permeate the American mind the decision was made to remove Native Americans westward under a president who regarded treaties with Native Americans as absurd.[171]

Lewis and Clark could not deny that sections of the West had a distinct desert character. Yet, they had reservations about painting Jefferson's purchase as anything but fertile. Zebulon Pike, however, held no such misgivings. The reasons for his shifting visions are open to speculation, but his legacy as one of the progenitors of the desert-West in the American imagination is clear. Similarly, Stephen Harriman Long granted this arid understanding of the West more purchase with the American public. The West

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[170] Billington and Ridge, *Westward Expansion*, 111-112.; Dillon, "Stephen Long's Great American Desert," 104.; Hollon, *The Great American Desert*, 66.

[171] Yet, historian of government policy regarding Native Americans, Francis Paul Prucha was emphatic that "the removal plan was never a scheme to dump the Indians into the desolate wastes of the Great American Desert." If, as Prucha maintained, the U.S. government made all possible efforts to ensure that the land was habitable for Native Americans, the question remains why perfectly good land was simply given away to a population regarded as an impediment to civilized progress.; (Francis Paul Prucha, "Indian Removal and the Great American Desert," *Indiana Magazine of History* 59, no. 4 (1963): 319-322.); For evidence of President Jackson's views on Native Americans as impediments to progress, and their eventual need to assimilate, see: Andrew Jackson, "Andrew Jackson's Message to Congress 'on Indian Removal'," in *Records of the United States Senate, 1789-1990* (National Archives, 1830).; John Buchanan, *Jackson's Way: Andrew Jackson and the People of the Western Waters* (New York: Wiley, 2001), 136.; For more information on the Indian Removal Act and Andrew Jackson, see: Anthony F. C. Wallace and Eric Foner, *The Long, Bitter Trail: Andrew Jackson and the Indians* (New York: Hill and Wang, 1993).; See also, Washington Irving's 1836 *Astoria* where he stated that with the Indian Removal Act, he was concerned "[w]e are contributing incessantly to swell this singular and heterogeneous cloud of wild population that is to hang about our frontier, by the transfer of whole tribes of savages from the east of the Mississippi to the great wastes of the far west."; (Washington Irving, Astoria; or, Enterprise Beyond the Rocky Mountains, 3 vols., vol. II (London: Richard Bentley, 1836), 58.)

had undergone a dramatic transformation. It was not a physical transformation, for the western landscape had not changed in the matter of two decades. The alteration was in the American psyche. Dreams of a garden dried up and dominated geographical representations for decades.

Conclusion

The West had already proved plastic in the imagination. From a garden to a desert, the vision of the West changed over less than a decade, driven largely by further exploration into the vast reaches of North America. By mid-century, though, science and technology began to reenergize the belief in the garden-West. Together they spoke to the impermanence of the landscape and the human capacity to mold it to America's Manifest Destiny. For many, the West was a land of promise – where the nation's destiny would be realized and individual success would be found in the earth. As will be discussed in the following chapters, the science performed in the West and the increasing use of industrial technologies began to rapidly uncover the geological history of the region. It was not simply the man of science who knew how the West once was, but, as will be shown in Chapters 4 and 5, the wider public began to gain access to popular and scientific interpretations of the ancient remains that lay along and beneath the path of westward progress.

The mental landscape for accepting the malleability of the West and the geological reality of the Western Cretaceous Interior Seaway was first a cartographic phenomenon. It started as early as 1622 when California was made into an island with a sea between the main continent of North America. Wrapped up in this island error were

hopes for the West's potential as a passage to riches or an agricultural Eden. Setting up cartographic notions of this seaway as well as thinking about the potential for a passage or Western Sea for travel made it possible for an easier acceptance of the West as a former seascape and therefore a plastic environment.[172]

As will be demonstrated in the next three chapters, when geologists, miners, paleontologists, and the public discovered fossils in the West, this cartographic "mistake" took a new form in the ancient reality of a lush and Edenic West. In time, Island California became merely a cartographic blunder rather than a wholesale error of vision. Early cartographers were representing something that did exist to a certain extent, only many millions of years previous. There is no way that they could have known this, but the mapmakers nonetheless began to open up an imaginative space in which the West could come to be seen as far more malleable and plastic than previously believed. The vision of California as an island was one of the many dreams that the mysterious West inspired and that later made it possible to think of the region in new ways. The dreams that the island fostered also encouraged exploration into this Eurocentric *terra (in)congita*.

Even as the cartographic reality of California as an island faded from the map by the late eighteenth century, it endured into the next century as an echo in the landscape. As scholars Rebecca Solnit and Dora Polk have suggested, California was in many ways an isolated island up until the first transcontinental railroad tied it to the rest of the North

[172] Allen, *Lewis and Clark and the Image*.

American continent.[173] Railroad speculators and boosters put the imagined sea to work to recreate the West as a once and future Eden full of fertile land and gold. As soon as the railroads bridged the seascape, they sought to conjure its ghost and put it to use for another purpose.

The geologic history of California even found its way into the island myth and in a sense resonates with what is now known about the nature of its deep past. For example, in General E. D. Townsend's diary of his 1855 travels in California he stated,

> [w]e had a long, hot and sandy ride of 34 miles, without water, to-day, our object being to reach Kern River. It has been a tradition, and is recorded in an old book written by the Jesuits on this Coast, that the part of California West of the Tulare Valley, in which we now are, was formerly an Island, and that this Valley was the bed of a large sheet of water, probably part of an ocean. There are evident signs of this being the case, all along our road to-day.[174]

"In several places," Townsend explained, "acres of ground are covered with small smooth stones, exactly such as one found on a sea beach, or the banks of a river."[175] As we shall see, there was often a tendency in diaries and journals of western travel and exploration for the author to dig deep into the past for water when they were plagued by thirst and surrounded by signs of aridity. Even though the water would not return to remedy Townsend's parched plight, recognizing the plasticity of the landscape is a crucial skill in geological thinking. Given contemporary knowledge of plate tectonics it is now known that much of what we call California was once under the sea and that in time

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[173] Rebecca Solnit, "An Island Is Anything Surrounded by Difference: Thoughts on Maps and History," The Bill Lane Center for the American West, posted November 12, 2013, accessed June 21, 2014. http://west.stanford.edu/news/island-anything-surrounded-difference-thoughts-maps-and-history.; Polk, *The Island of California*.

[174] Polk, *The Island of California*, 330-331.; E. D. Townsend, *The California Diary of General E. D. Towsend* (Los Angeles, CA: W. Ritchie Press, 1970), 129-130.

[175] Townsend, *The California Diary of General E. D. Towsend*, 130.

portions of the state may indeed separate and become an island.[176] The same can be said of the return of the Western Cretaceous Interior Seaway. If global warming through climate change occurs as it is expected to by many scientists, sea levels could rise and inundate low-lying areas of the North American continent and create a greenhouse planet similar to the environment of the Cretaceous. The resources extracted from geologic time have underwritten this process. As a result of this warming, we could see the opening up of the Northwest Passage for the unhindered travel dreamed of by Jefferson and his contemporaries.[177] In terms of geologic timescales, the earth is indeed quite plastic as physical reality. As this chapter has demonstrated, the changing visions of the American West during the past five centuries illustrate that the earth is also quite plastic in the human imagination.

Hopes for a Northwest Passage and a garden-West were intimately tied to the developing science of the geologic history of the earth. The eventual passage to China was created not through a water course across the continent, but rather through resources generated from ancient seas and lakes. Coal, a resource now coveted by the Chinese and conveyed to that country via American railroads, fueled the creation of the network of transcontinental railroads that enabled the settlement of the American West. Dreams of a passage to the Orient were fueled by an imagined seaway in the West. These dreams drove exploration into the vast region, though the fabled seaway proved illusory. Yet, in

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[176] Polk, *The Island of California*, 331-332.

[177] John McGarrity and Henning Gloystein, "Big freighter traverses Northwest Passage for 1st time," September 27, 2013. *Reuters*, accessed February 16, 2015. http://www.reuters.com/article/2013/09/27/us-shipping-coal-arctic-idUSBRE98Q0K720130927.; Legal issues pertaining to the Northwest Passage are examined in Mahealani Krafft, "The Northwest Passage**:** Analysis of the Legal Status and Implications of its Potential Use," *Journal of Maritime Law & Commerce* (October 2009): 537-578.; J. L. Granatstein, "Does the Northwest Passage Still Matter? The Shrinking Arctic Ice Cap May Soon Ease Canada's Sovereignty Problem" *The Globe and Mail (Canada)*, January 12, 2009.

time, an ancient seascape came into view in the minds of scientists, further feeding the dreams of the nation to settle the garden of the West. Fossils and fossil fuels dug from the depths of time helped to restore and reclaim that garden and build a Passage to India. In a subsequent twenty-year span, the garden and desert visions of the West battled with similar weaponry, but the conflict was amplified by scientific exploration and the energies of fossil fuels.

Dreams often have a hard time meeting a timely demise. As will be shown in later chapters, quests for the Northwest Passage and the later hopes for an agricultural Eden in the West have much in common. Uncharted lands are especially malleable and subject to the desires of those who wish to find riches or a promised land. As myths were dispelled about the geography of the West, the geology of the region brought to bear more myths. Later chapters will show how explorers, scientists, and settlers experienced the geologic history of the West through the remains that littered the region. We have long been chasing the Western Sea.



Figure 7. America Septentrionalis (1636). Source: “AMERICA SEPTENTRIO= NALIS” by Hendrik Hondius and Jan Jansson, 1636, in the “Glen Mclaughlin Map Collection,” accessed January 24, 2014. http://purl.stanford.edu/cq445xf9935.



Figure 8. America (1679). Source: "America" by John Seller, 1679, in the "Glen Mclaughlin Map Collection," accessed January 25, 2014. http://purl.stanford.edu/yd107yk8237.



Figure 9. The North Part of America (1625). Source: “The North part of America conteyning Newfoundland, New England, Virginia, Florida, New Spaine and Nova Francia, with ye riche Iles of Hispaniola, Cuba, Jamaica, and Porto Rieco, on the south, and upon ye west the large and goodly island of California” by Henry Briggs, Renold Elstracke, and Samuel Purchas, 1625, in the “Glen Mclaughlin Map Collection,” accessed February 12, 2014. http://purl.stanford.edu/sy409bk9698.



Figure 10. A New and Most Exact Map of America (1671). Source: A New and most Exact map of AMERICA" by John Overton, 1671, in the "Glen Mclaughlin Map Collection," accessed February 2, 2014. http://purl.stanford.edu/fy697rn5092.

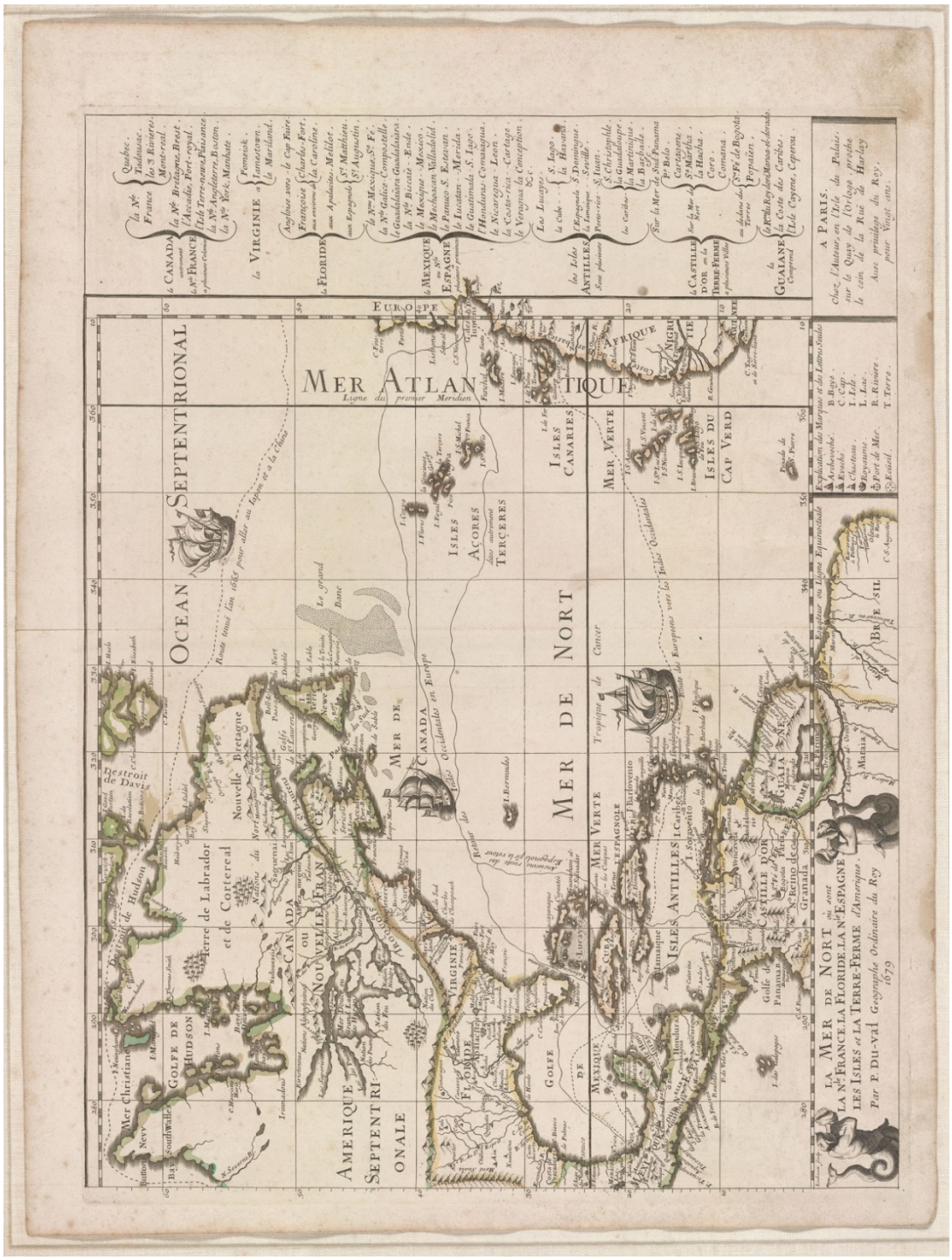


Figure 11. La Mer De Nort (1679). Source: LA MER DE NORT ou sont LA Nle." by Pierre Duval, 1679, in the "Glen Mclaughlin Map Collection," accessed January 14, 2014. http://purl.stanford.edu/jy081yq8216.



Figure 12. A New, Plaine, and Exact Map of America (1660?). Source: “A NEW, Plaine, and Exact Map of AMERICA” by Robert Walton, [1660?], in the “Glen Mclaughlin Map Collection,” accessed February 14, 2014. http://purl.stanford.edu/bx376jn7462.

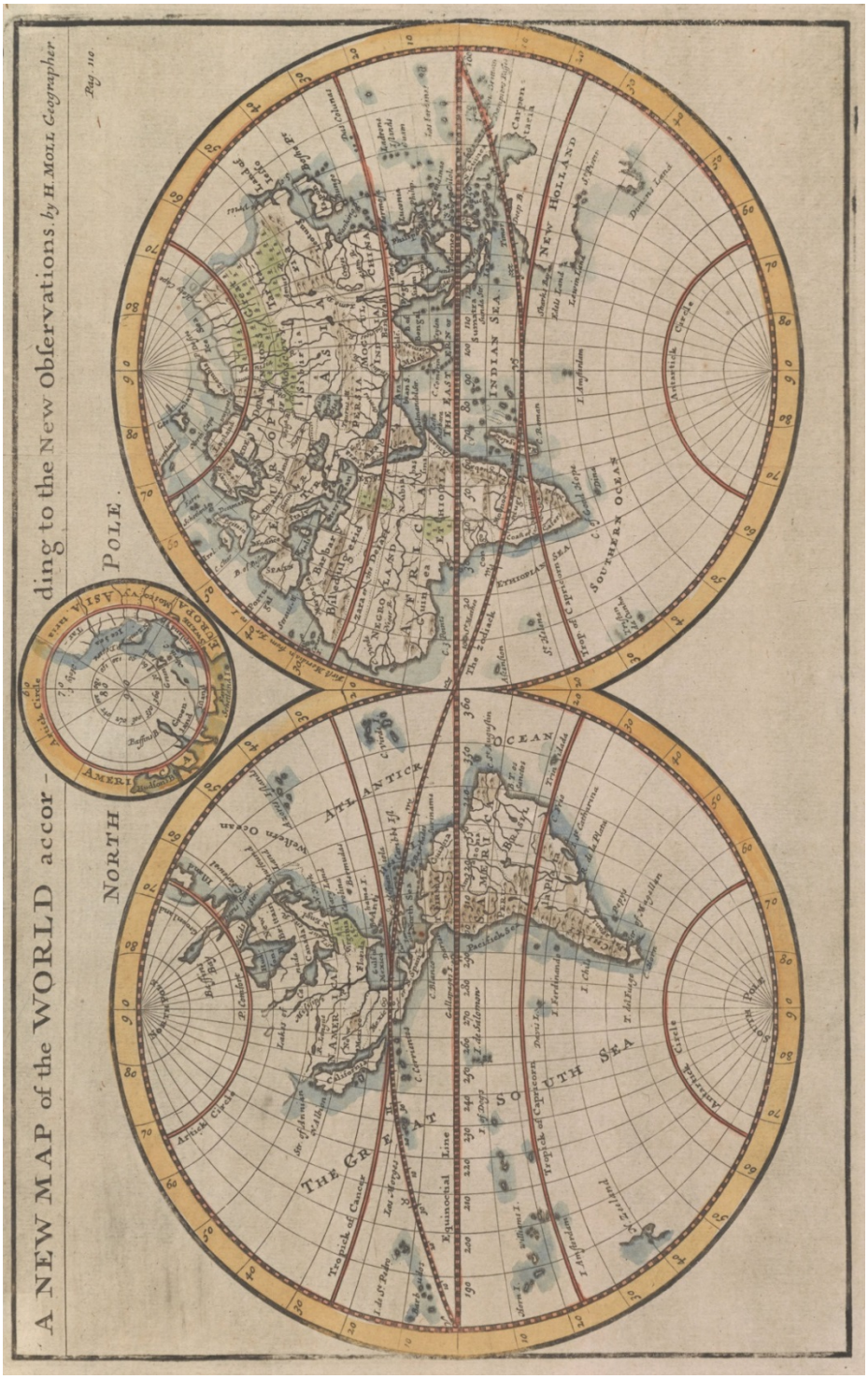


Figure 13. A New Map of the World (1711?). Source: “A NEW MAP of the WORLD according to the New Observations” by Herman Moll, [1711?], “Glen Mclaughlin Map Collection,” accessed January 14, 2014. http://purl.stanford.edu/tx385st3900.



Figure 14. Amerique Septentrionale (1719). Source: "AMERIQUE SEPTENTRIONALE…" by Sanson, Nicolas and Jaillot, Alexis Hubert, 1719, in the "Glen Mclaughlin Map Collection," accessed January 14, 2014. http://purl.stanford.edu/cy999sm3297.



Figure 15. A New & Correct Map of the Whole World (1719). Source: “A new & correct map of the whole world” by Herman Moll, 1719, “Glen Mclaughlin Map Collection,” accessed January 30, 2014. http://purl.stanford.edu/fq505jv7833.



Figure 16. [North America] (1720). Source: "[NORTH AMERICA]" by George Willdey, 1720, in the "Glen Mclaughlin Map Collection" accessed January 16, 2014. http://purl.stanford.edu/gz393fx6652.

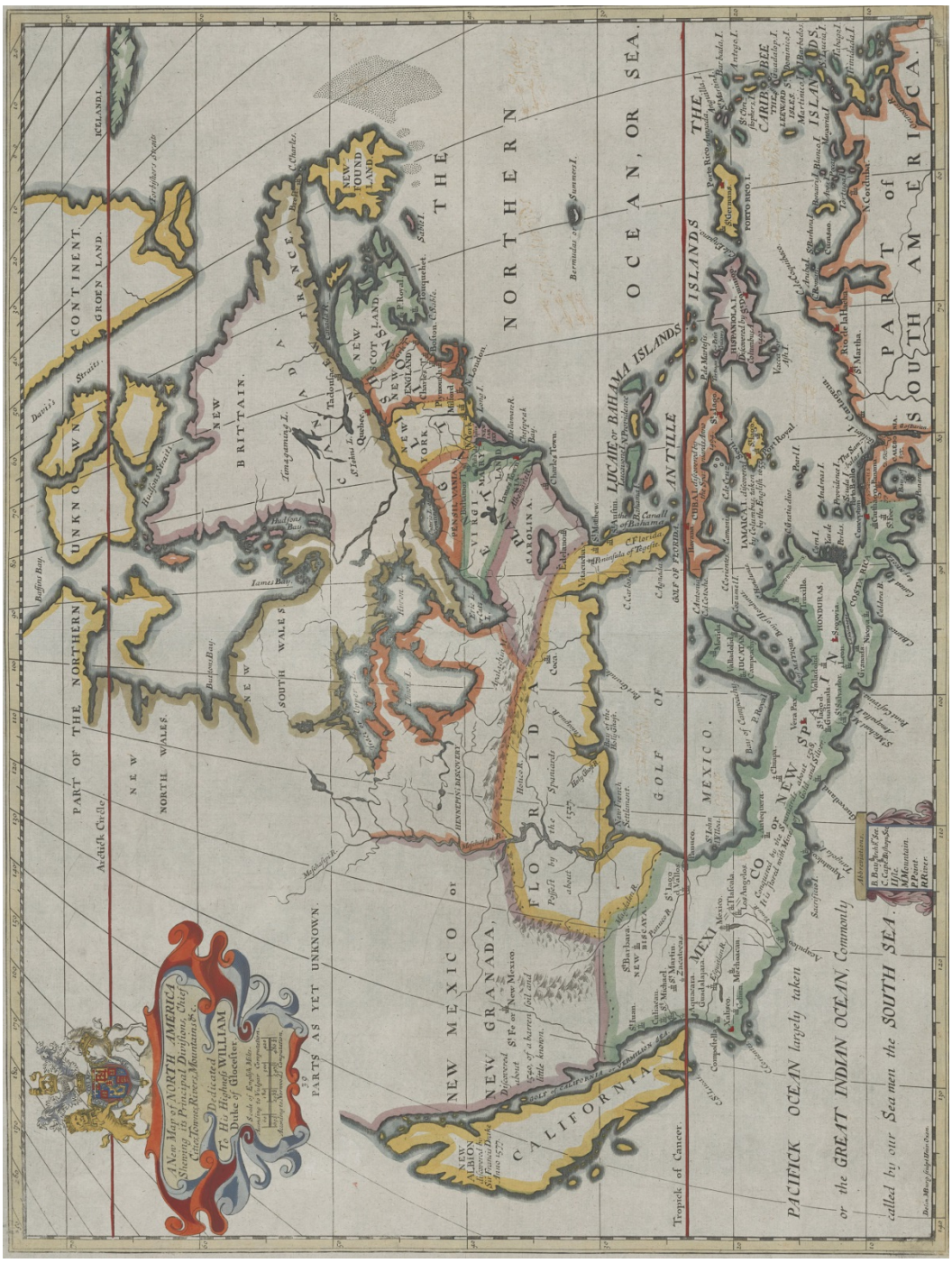


Figure 17. A New Map of North America (1704). Source: "A New Map of NORTH AMERICA Shewing its Principal Divisions, Chief Cities, Townes, Rivers, Mountains, &c." by Edward Wells, 1704, in the "Glen Mclaughlin Map Collection," accessed January 20, 2014. http://purl.stanford.edu/jc636bs9794.

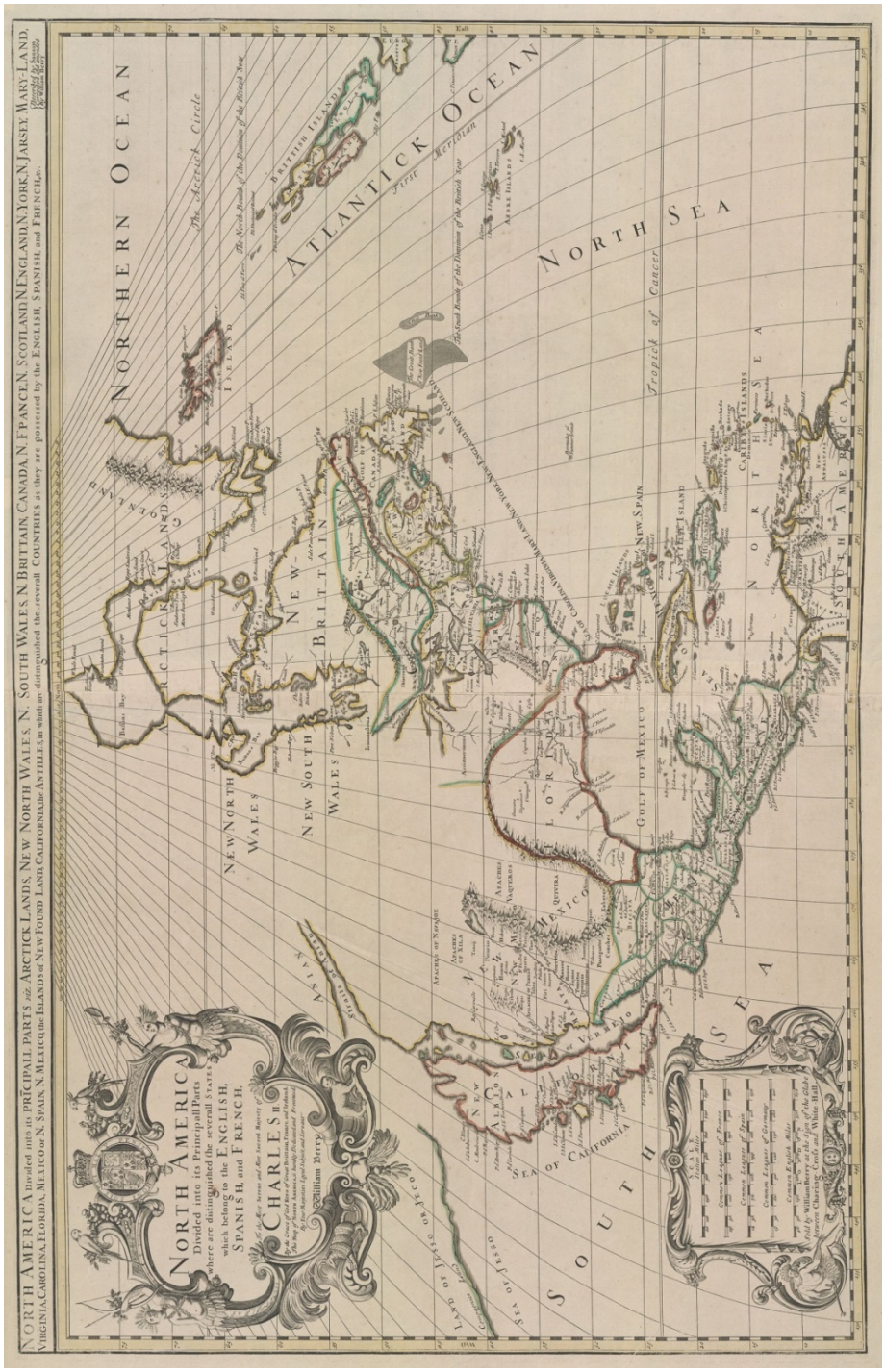


Figure 18. North America (1680). Source: “NORTH AMERICA Divided into its PRICIPALL PARTS...” by William Berry and Nicolas Sanson, 1680, in the “Glen Mclaughlin Map Collection,” accessed February 8, 2014. http://purl.stanford.edu/ph181rd0542.

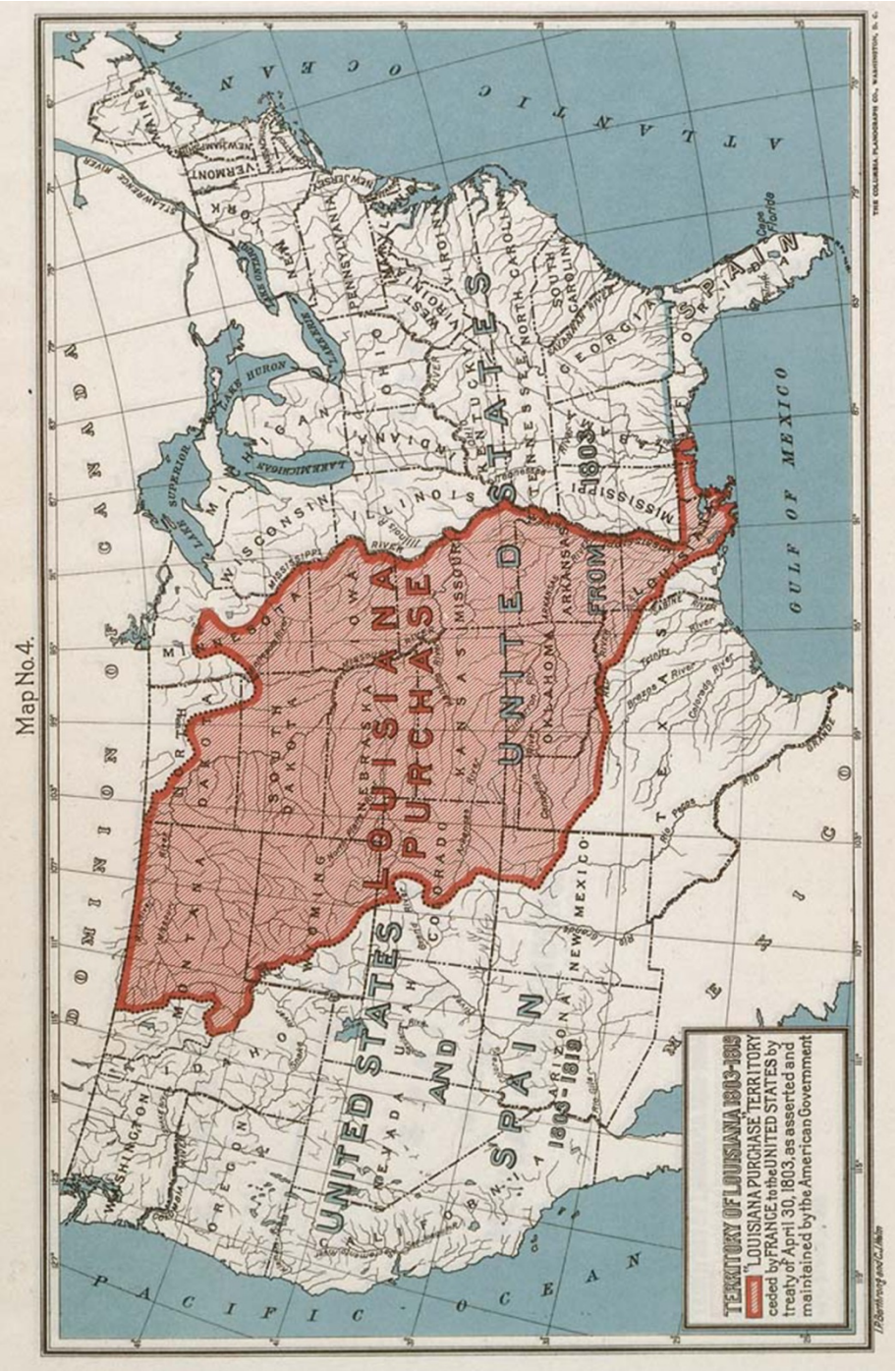


Figure 19. Map of the Louisiana Purchase Territory (1903). Source: National Archives, Online Public Access, Record Group 49, Records of the Bureau of Land Management, accessed March 20, 2015. http://research.archives.gov/description/594889.



Figure 20. Lewis and Clark's Track (1814). Source: Samuel Lewis, “A map of Lewis and Clark's track across the western portion of North America, from the Mississippi to the Pacific Ocean : by order of the executive of the United States in 1804, 5 & 6 / copied by Samuel Lewis from the original drawing of Wm. Clark,” London: Longman, Hurst, Rees, Orme & Brown. From Library of Congress, *Map Collections*, accessed February 18, 2015. http://hdl.loc.gov/loc.gmd/g4126s.ct000763.

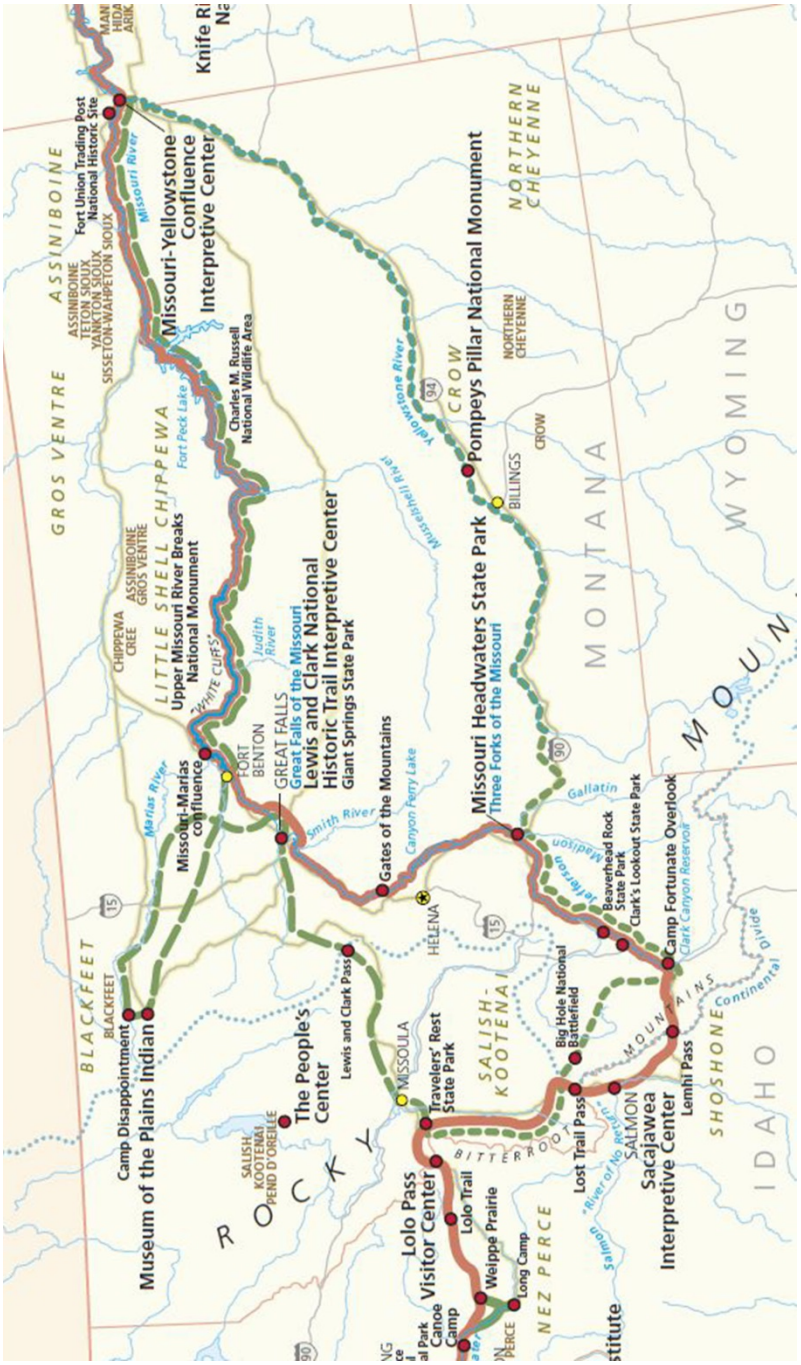


Figure 21. Map of the Lewis and Clark National Historic Trail Centered on Montana. Source: “Lewis & Clark National Historic Trail,” National Park Service, accessed March 5, 2015. http://www.nps.gov/lecl/planyourvisit/maps.htm.



Figure 22. A Chart of the Internal Part of Louisiana (1810). Source: Zebulon Montgomery Pike, "A chart of the internal part of Louisiana : including all the hitherto unexplored countries, lying between the River La Platte of the Missouri on the N., and the Red River on the S., the Mississippi east, and the mountains of Mexico west, with a part of New Mexico & the Province of Texas," Philadelphia, PA: 1810. From Library of Congress, *Map Collections*, accessed February 18, 2015. http://hdl.loc.gov/loc.gmd/g4040.ct003060.

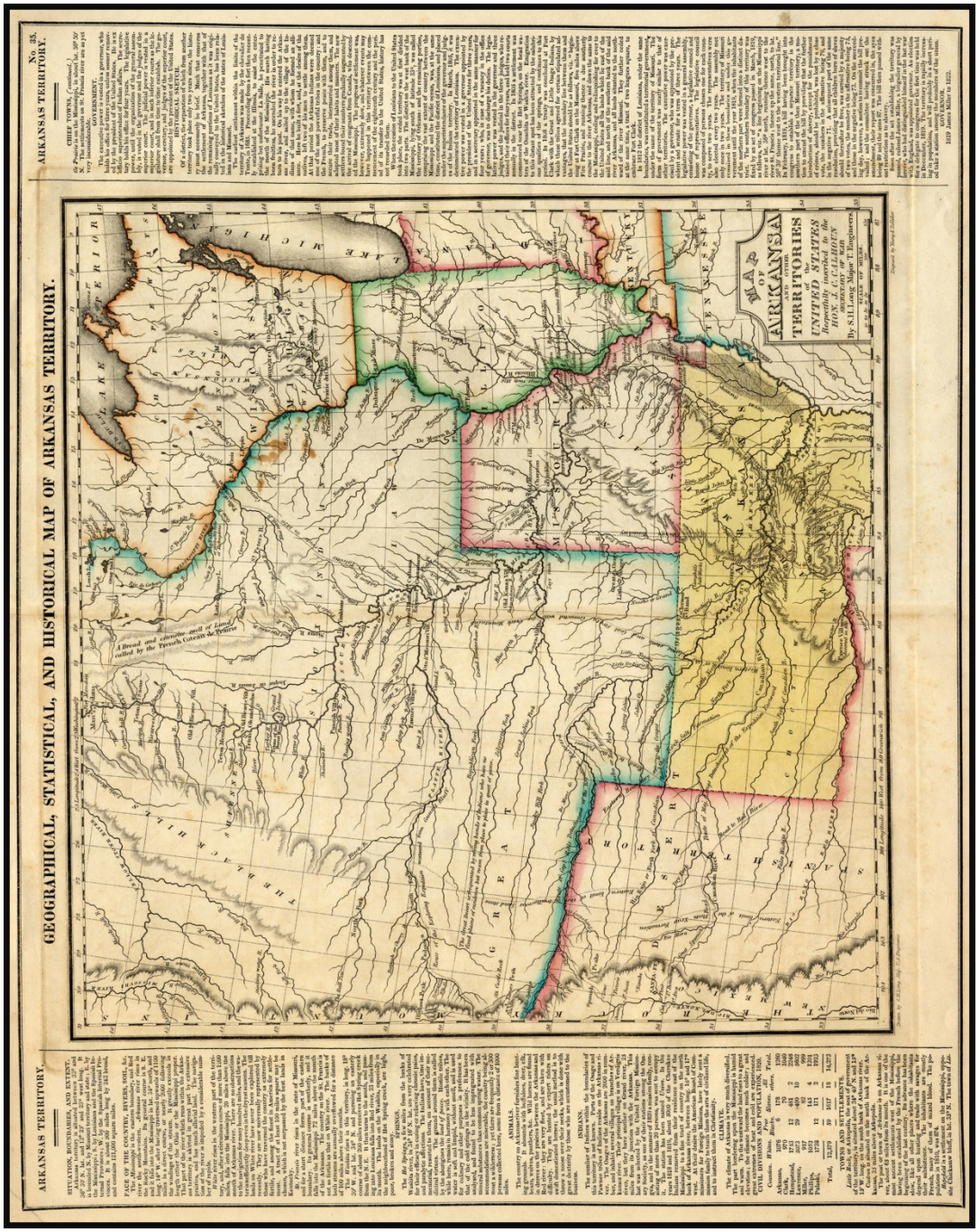


Figure 23. The Great American Desert (1822). Source: "Maps of the American West, Stephen H. Long's 1822 Geographical, Statistical and Historical Map of Arkansas Territory (from the Carey and Lea Atlas of 1822)," McFarlin Library, Department of Special Collections and University Archives, The University of Tulsa, accessed June 14, 2014, http://www.lib.utulsa.edu/Speccoll/collections/maps/long/index.htm.

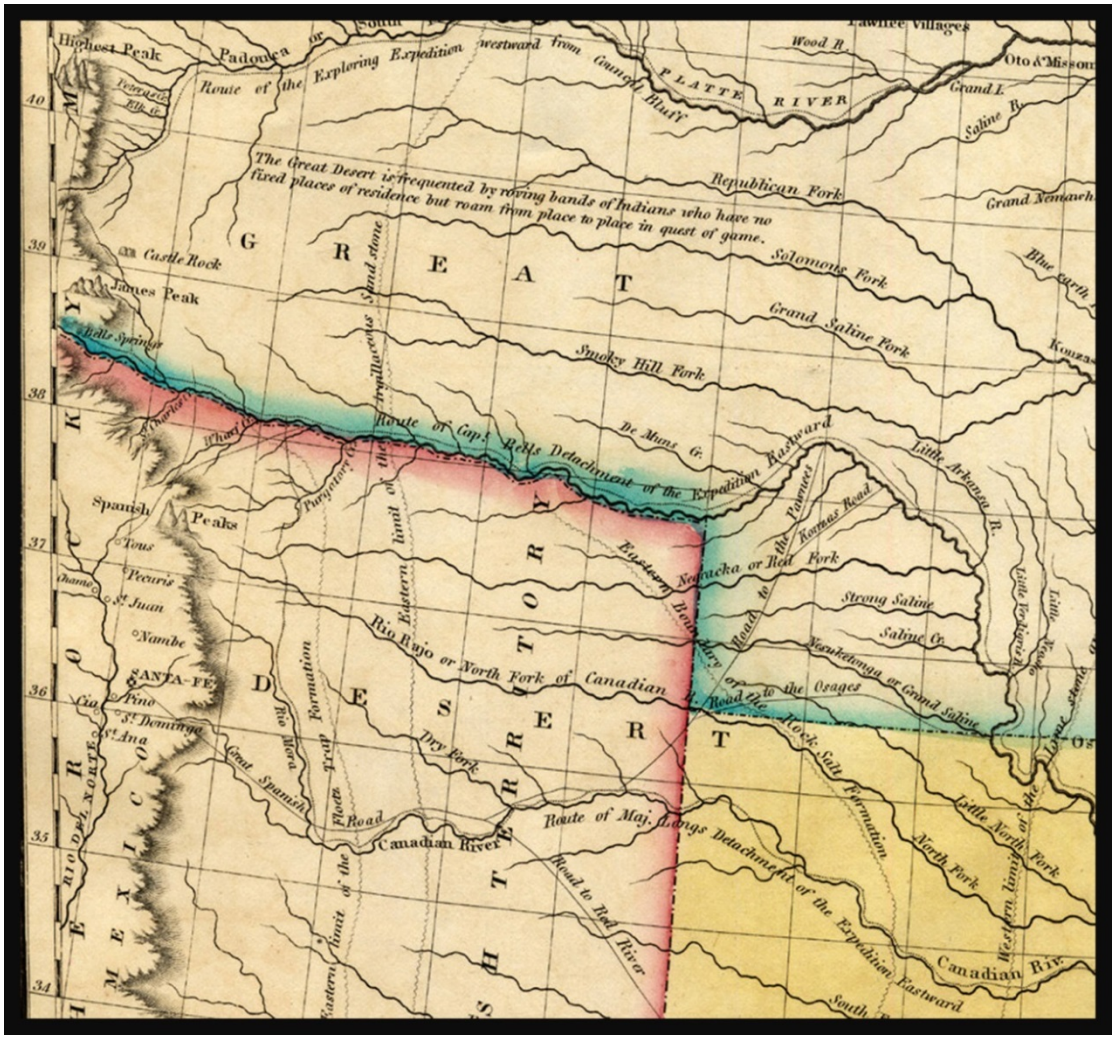


Figure 24. The Great American Desert Zoom (1822). Source: “Maps of the American West, Stephen H. Long’s 1822 Geographical, Statistical and Historical Map of Arkansas Territory (from the Carey and Lea Atlas of 1822),” McFarlin Library, Department of Special Collections and University Archives, The University of Tulsa, accessed June 14, 2014, http://www.lib.utulsa.edu/Speccoll/collections/maps/long/index.htm.

THE POWER OF THE GEOLOGIC PAST: MAKING DEEP TIME RELEVANT TO 19TH CENTURY AMERICA

> Tis now more than Five Thousand Years since our World was made, and tho' it would be a great Pleasure to the Mind, to recollect and view at this Distance those first Scenes of Nature; what the Face of the Earth was when fresh and new, and how things differ'd from the State we now find them in, the Speculation is so remote, that it seems to be hopeless, and beyond the last Posterity of the first Men, and faln into the dying Age of the World; by what Footsteps, or by what Guide, can we trace back our Way to those first Ages, and the first Order of Things? And yet, methinks, it is reasonable to believe, that Divine Providence, which sees at once throughout all the Ages and Orders of the World, should not be willing to keep Mankind finally and fatally ignorant of that part of Nature and of the Universe, which is properly their Task and Province to manage and understand. We are the Inhabitants of the Earth, the Lords and Masters of it.[1]
> ~Thomas Burnet in *The Sacred Theory of the Earth*, 1719.

The debates surrounding California's status as an island overlapped with what many historians have regarded as the initial challenge to Christian orthodoxy by the new deep time thinkers. This process was not swift nor was it fully achieved in the nineteenth century. I argue that it is necessary to recognize the crucial element that geologic history and geologic time played in the public perception of the plasticity of the West. If the changes being uncovered by geologists had occurred over vast scales of time, then what hope was there that useless land would change for the better in the near future? Still, many Americans also believed they lived in a chosen nation imbued by God with special purpose. If revolutions once racked the globe, as geologists suggested, then God or Divine Providence could surely enact the necessary changes more quickly, or simply give

[1] Thomas Burnet, *The Sacred Theory of the Earth*, 2 Vols., Vol. 1 (London: Printed for John Hooke, 1719), 10.

humans the capacity to restore the West to its Edenic origins on their own schedule. Natural changes – with perhaps a dash of divine assistance – were considered possible. But ultimately it would fall to humans to use the abundant reservoirs of coal that Providence had provided to remake the world. For contemporaries thinking about the future of the American West, the ultimate triumph of geologic history was not its expansion of humanity's concept of time, but rather in its provocative suggestion that the world was a far more malleable place than had previously been thought.

The overlapping debates about an island California and deep time can be viewed in one of geology's earliest texts considering the age of the earth and its geophysical cycles: Thomas Burnet's *The Sacred Theory of the Earth* completed in 1690.[2] One historian regarded Burnet, who was an Anglican Reverend, as "the first of the geological time-travellers," a "conquistador of that most foreign of all countries, the remote past."[3] Rather than conquering the unfathomable depths of deep time, however, Burnet was one of the first men to cast the imperial gaze into the heart of the earth. Burnet's rough sketch of deep time enabled future geologists to better understand the Earth and thereby more effectively extract both its fossil and fossil fuel wealth.

A trip to the Alps drove Burnet to see the world anew. He found the mountains inspiring, but their heights had shown him a terribly disordered world below.[4] This troubled him because he believed that if God's world was perfect it should not have a ragged and jumbled topography. Unsurprisingly, as a clergyman, Burnet called upon the

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[2] Burnet, *The Sacred Theory of the Earth*, Vol. 1.
[3] Robert Macfarlane, *Mountains of the Mind: Adventures in Reaching the Summit* (New York: Vintage, 2004), 30-31.
[4] Macfarlane, *Mountains of the Mind*, 23-24.; Stephen Baxter, *Ages in Chaos: James Hutton and the Discovery of Deep Time*, (New York: Forge, 2004), 51.

explanatory power of the Bible to interpret this disorder.[5] Yet this was not a work of one-hundred-percent biblical literalism. He did not call upon miracles, but rather natural causes to understand the history of the earth.[6] In exchanges with his friend Isaac Newton, Burnet was even more adamant than Newton about adhering to physical laws rather than the power of God's hand.[7] In his work, he labored to unite early geological theory, Cartesian natural philosophy, and Scripture.[8] Burnet firmly believed that "[w]e are not to suppose that any Truth concerning the Natural World can be an Enemy to Religion; for Truth cannot be an Enemy to Truth."[9]

In particular, he saw the early earth as a paradise, the Bible's Eden, which was subsequently turned to ruins by the great Flood. His work, he admitted, was "writ with a sincere Intention to justify the Doctrines of the Universal Deluge," which was "the greatest Thing that ever yet hapned in the World."[10] After the chaos of creation, the earth's surface was featureless, smooth, and perfect until it cracked open, created mountains along those cracks, and released an all-consuming ocean from the depths.[11] At the time he was writing he regarded the Fallen earth as "broken Materials of that first World," simple "Ruins," and "a rude Lump."[12] Eventually, the earth would fall into a dramatic drought and subsequently be consumed and cleansed by fire to be made anew

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[5] For an examination of the role of Scripture and the Bible in geology, see: Charles Gillispie, *Genesis and Geology: A Study in the Relations of Scientific Thought, Natural Theology, and Social Opinion in Great Britain, 1790-1850* (Cambridge, MA: Harvard University Press, 1996).
[6] Stephen Jay Gould, *Time's Arrow, Time's Cycle: Myth and Metaphor in the Discovery of Geological Time* (Cambridge, MA: Harvard University Press, 1987), 28-29.
[7] Gould, *Time's Arrow, Time's Cycle*, 40-41.
[8] Martin J. S. Rudwick, *Bursting the Limits of Time: The Reconstruction of Geohistory in the Age of Revolution* (Chicago, IL: University of Chicago Press, 2005), 134.
[9] Burnet, *The Sacred Theory of the Earth*, Vol. 1, xx.
[10] Burnet, *The Sacred Theory of the Earth*, Vol. 1, xxiii, 13.
[11] For a readable summary and explanation of Burnet's work and impact, see: Gould, *Time's Arrow, Time's Cycle*, 21-59.
[12] Burnet, *The Sacred Theory of the Earth*, Vol. 1, Dedication, 208.

for the future reign of Christ.[13] This conflagration of continents, Burnet surmised, would be represented well in Britain owing to the island's copious quantities of coal.[14] This cycle was clearly represented in Burnet's frontispiece [Figure 25]. Burnet's work was widely read in the seventeenth century, and he quickly became *the* theorist one had to wrestle with in contemplating the history of the Earth.[15] His notions also helped stir the imaginations of the Romantics who experienced the historied and majestic landscapes of the earth as sublime.[16] Ironically, his biblically-minded geological history was based on the six-thousand-year biblical history of the earth, but in time the controversy it provoked helped to erode the grip of scriptural timescales in early geology.[17]

Because he wrote *The Sacred Theory* during the late seventeenth century, Burnet's work also coincided with the popular representation of California as an island. Consequently, contained within his work was a map of North America with California floating off of its western coast [Figure 26]. The very popularity of Burnet's work ensured that the image of California as an island would be perpetuated in popular and educated imaginations for years to come. Island California was now enshrined in this seminal work covering the history of the earth. Geologists viewing the text saw in this map a sea in the West that looked surprisingly similar to the Western Cretaceous Interior Seaway that subsequent explorers encountered through its material remains. In *The Sacred Theory*, one can see the changing vision of the dynamic history of the earth and

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[13] Jack Repcheck, *The Man Who Found Time: James Hutton and the Discovery of the Earth's Antiquity* (Cambridge, MA: Perseus, 2003), 97.; Baxter, *Ages in Chaos*, 53.
[14] Burnet, *The Sacred Theory of the Earth,* Vol. 2, 90.
[15] Macfarlane, *Mountains of the Mind*, 29.; Alan Cutler, *The Seashell on the Mountaintop: A Story of Science, Sainthood, and the Humble Genius Who Discovered a New History of the Earth* (New York: Dutton, 2003), 171.
[16] Macfarlane, *Mountains of the Mind*, 29.
[17] Baxter, *Ages in Chaos*, 54-55.

the hopes for what would be found in the North American West. Furthermore, as we shall see in later chapters, Burnet's blend of biblical progress and a cyclical history of the Earth was similarly represented in the late nineteenth century use of fossils to boost the West.[18] He understood the history of the earth as fulfilling a process where "the whole Circle of Time and Providence be completed."[19] Fossils could be seen as signs of organic progress in an age where industrialization and technology made progress seem inevitable and even Providential. But they also could be viewed as evidence of a future Edenic earthly revival of verdant western environments. The biblically infused language that Burnet used to describe geological time such as "Ante-diluvian" persisted well into the late nineteenth century.[20] Like many settlers and those who had faith in Manifest Destiny, the Providence of western settlement, and the promise of reclamation, Burnett also shared the vision of humans as "Lords and Masters" of the earth.[21]

Geological treatises like Burnet's, as well as textbooks and mining manuals, provide an effective means of analyzing the dispersal and state of knowledge of geologic history and the nature of coal. These texts reveal that while many theories were in dispute concerning the processes of geologic change, all agreed that the earth had a history.[22] Deep time was ascertained in no small part because of the leisure time afforded to men of science by coal, and it became an explanatory mechanism for the changes seen in the geological record as reflected in fossils. In explaining deep time, the theory's progenitors

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[18] For a discussion of Burnet's process of reconciling these competing images, see: Gould, *Time's Arrow, Time's Cycle*, 46-51.
[19] Burnet, *The Sacred Theory of the Earth*, Vol. 1, 3.
[20] Burnet, *The Sacred Theory of the Earth*, Vol. 1, 11.; "Remains of Gigantic Antediluvians," *Scientific American*, June 15, 1878.
[21] Burnet, *The Sacred Theory of the Earth*, Vol. 1, 10.
[22] Process often involved or implied time in these debates.

could scarcely help but see the Earth as self-renewing and time as cyclic. Due to its utility in the industrializing nations of Britain and America, coal was one of the most evident signs of that history. The fossils embedded in coal showed the traces of ancient environments. Coal also showed humanity how powerful they could become, promising the means to overpower nature and take control of the changes they were observing in the geological record. However, coal's relationship to the acceptance and rejection of deep time has not been fully realized by historians.

Acceptance of deep time may have been growing, but it was only useful for certain segments of the population and for particular goals. What was important was the cyclical history that geology revealed. The earth was plastic and remolded itself in a sustainable and Providential manner. In this context, coal mining was not just important for the energy it freed for industrialization, but also for what it revealed about paleo-environments through the plant matter contained within coal seams. Coal and the growing concept of geologic history were essential to reconstructing paleo-environments in all their vibrant diversity, rather than just relying on the charismatic fossilized megafauna of the Antediluvian age. A powerful impetus for action emerged from the tightly linked connections between deep time's cyclical nature, the Providence and nature of coal, geologic history and imagination, and the physical power to change the world.

This chapter examines geological treatises, textbooks, and mining manuals in order to assess the rise of geology as a science in America, the initial impact of signs of a changing world embedded in coal, the religiosity of coal, and deep time's irrelevance in a high-energy society fueled by coal. The chapter begins with deep time's cyclical qualities

and the rise of geological history as revealed in the work of James Hutton and Charles Lyell. It then turns to the divine qualities of coal in industrial societies. Coal was central to the ways in which many scriptural and deistic geologists understood the beneficent will of God revealed in the geological record. Because of its contributions to revolutionizing modern life, coal was seen as gift and the fuel of civilization. Coal was a useful tool and played a significant role in the rise of American geology. It also opened up windows into the ancient earth where the tropical flora of times past could be viewed and touched by scientists and miners alike. The history of the earth was revealed in these coal seams. The next section describes two elements of geological practice that form the basis for seeing the past through fossil remains. Geologists have regularly used historical analogy and vivid imaginative journeys in order to know the ancient environments that they investigate. Lastly, the chapter addresses how nineteenth-century scientists recognized the human capacity to alter the earth using coal. Geological processes were condensed when this geological fuel was released and rewilded.

Deep Time's Cyclic Quality

The past's proximity was affected by the manner in which geologic time, or deep time, was conceived by its founders. Elements of James Hutton and Charles Lyell's work to broaden imaginations to embrace the Earth's imponderable age served to undermine their project. This section looks through the writings of Hutton and Lyell to reveal the deism, periodization or cycles, and anthropocentrism that problematized the already difficult-to-grasp idea of deep time. Their work was situated in the context of Britain's coal-fueled industrialization where human abilities to alter the natural world were

accelerating in time and expanding in space. Industrialization provided leisure time for certain classes of British society to ponder the nature of the world. It was within this context that deep time was discovered and destroyed.

Deep time is the term often used to describe the vast expanses of time that are required for geological change. Absent the aid of radiometric dating, the true depth of time required for these transformations could not be fully appreciated in the nineteenth century.[23] Nevertheless, by the middle of the nineteenth century, there was wide recognition that the earth too had a history and scientists probed how that history expressed itself in its structure and composition. They accessed material nature and were able to envision ancient environments. Challenging James Ussher's shallow biblical chronology of the earth (which began on Sunday October 23, 4004 BC), the images and scientific descriptions that emerged from these treks through deep time aided in the recognition of the expanses of geologic time.[24] One of the major hurdles for accepting deep time was to understand human history as distinct from the history of the earth. This began to take hold in the 1860s during what Daniel Lord Smail has labeled "the time

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[23] This would take until the early twentieth century to develop into a technique for accurately dating rocks.;, Lawrence Badash, "The Age-of-the-Earth Debate," *Scientific American* (August, 1989): 90-96.; Mott T. Greene, *Geology in the Nineteenth Century: Changing Views of a Changing World* (Ithaca, NY: Cornell University Press, 1982), 276-280.

[24] Claude C. Albritton, *The Abyss of Time: Changing Conceptions of the Earth's Antiquity after the Sixteenth Century* (Mineola, NY: Dover Publications, 2002).; Baxter, *Ages in Chaos*.; Peter J. Bowler, *Evolution: The History of an Idea* 25th Anniversary Edition (Berkeley, CA: The University of California Press, 2009), 29, 234.; Peter J. Bowler, *Fossils and Progress: Paleontology and the Idea of Progressive Evolution in the Nineteenth Century* (New York: Science History Publications, 1976).; Joe D. Burchfield, *Lord Kelvin and the Age of the Earth* (Chicago, IL: University of Chicago Press, 1990).; Greene, *Geology in the Nineteenth Century*.; Rachel Laudan. *From Mineralogy to Geology: The Foundations of a Science, 1650-1830* (Chicago, IL: University of Chicago Press, 1987).; Rudwick, *Bursting the Limits of Time*.; Martin J. S. Rudwick, *The Meaning of Fossils: Episodes in the History of Paleontology* (Chicago, IL: University of Chicago Press, 1976), 70, 252-255, 264-265.; Martin J. S. Rudwick, *Worlds before Adam: The Reconstruction of Geohistory in the Age of Reform* (Chicago, IL: University of Chicago Press, 2008).; Stephen Toulmin and June Goodfield, *The Discovery of Time* (New York: Harper & Row, 1966).

revolution."[25] Smail considered the production of three texts the foundation for this revolution, yet it was started over 60 years earlier with the work of James Hutton. Though, like historians who ignored this deepening of time in the nineteenth century, some geologists and the members of the public disregarded its impact. They were caught in sacred chronologies and deistic progress narratives that elevated humanity above time as masters of the world.[26]

The transition to a wider acceptance of deep time was messy. Geology has not moved through history in a progressive fashion where a correct theory always triumphed cleanly over its incorrect antecedent.[27] A survey of the public's acceptance of the theories espoused by geologists in nineteenth century America has yet to be written, but it is likely that it would be equally complicated. Add to this that Christianity and deism pervaded eighteenth and nineteenth century geology.[28] Many authors sought to reconcile their spiritual beliefs with their observations of the natural world. Science and religion did not necessarily battle in the minds and societies of these men of science, but rather a fusion often took place.[29] Because there was no war, no victory could be claimed.[30]

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[25] Daniel Lord Smail, *On Deep History and the Brain* (Berkeley: University of California Press, 2008), 21, 26.; see also; Paolo Rossi, *The Dark Abyss of Time: The History of the Earth & the History of Nations from Hooke to Vico* (Chicago, IL: University of Chicago Press, 1984).

[26] Daniel Lord Smail,"In the Grip of Sacred History," *The American Historical Review* 110, no. 5 (2005): 1337-1361.; However, Donald Worster believed that with the discovery of deep time, human history and geologic history were united as one and the modern discipline of history was born.: (Donald Worster, "Nature and the Disorder of History," in Michael Soule and Gary Lease ed. *Reinventing Nature? Responses to Postmodern Desconstruction* (Washington: Island Press, 1995), 68-69.)

[27] Greene, *Geology in the Nineteenth Century*, 15.

[28] Laudan, *From Mineralogy to Geology*, 115-116.; Laudan addressed the eighteenth century, but it is clear from the analysis that follows in this dissertation that these trends did not disappear in the next century.

[29] Rudwick, *Worlds before* Adam, 564-565.

[30] Taken as a whole, the revision of the conflict thesis rejected the idea of a dichotomous and simple conflict between monolithic institutions of religion and science. It refuted the dominant "truth" of science in respect to the realm of "subjective" knowledge that religion reflected, and that religion and science were in fact distinct spheres of knowledge. The revision embraced complexity in the relationship between

Therefore, understanding knowledge production and the state of scientific knowledge during any historical period in America is an intricate and complicated process that often results in the absence of a defined set of scientific knowledge. Yet, it is vital to recognize that geological knowledge is socially produced discursive knowledge that contends with the strict constraints of a real material existence. [31] Knowledge of the natural world is experiential and can be interpreted in limited ways. [32] The representation of the natural world has limits since human sensory faculties are essentially standard, while the interpretation of the significance of the observations is to a greater degree influenced by "external" socio-cultural influences. Before coal had social utility in the context of industrialization, it was simply a compressed mass of fossilized vegetable matter that was occasionally exploited as fuel. There were clear signs of change written on the face of the Earth and embedded in coal, but what was less clear was their significance.

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religion and science and displayed the plurality of the interactions between historical actors who held certain beliefs during the rise of "scientific" inquiry. It resisted the temptation to impose an all-encompassing narrative over the multifaceted relationship that has been constructed as a discussion between two distinct realms of knowledge. The works that popularized the thesis that a war raged between science and religion are: John William Draper, *History of the Conflict Between Religion and Science* (New York: D. Appleton and Company, 1875).; Andrew Dickson White, *A History of the Warfare of Science with Theology in Christendom* (New York: D. Appleton-Century Company, Inc., 1896).; Alfred North Whitehead, *Science and the Modern World* (New York: The Free Press, 1925).; The thesis was overturned by works such as: Charles E. Rosenberg, *No Other Gods: On Science and American Social Thought* (Baltimore, MD: The Johns Hopkins University Press, 1961).; Ian G. Barbour, *Issues in Science and Religion* (New York: Prentice-Hall, Inc., 1966).; John Hedley Brooke, *Science and Religion: Some Historical Perspective* (New York: Cambridge University Press, 1991).; R. Hooykaas, *Religion and the Rise of Modern Science* (London: Scottish Academic Press, 1972).; James R. Moore, *The Post-Darwinian Controversies: A Study of the Protestant Struggle to Come to Terms with Darwin in Great Britain and America 1870-1900* (New York: Cambridge University Press, 1979).; Jon H. Roberts, *Darwinism and the Divine: Protestant Intellectuals and Organic Evolution 1859-1900* (Madison, WI: The University of Wisconsin Press, 1988).

[31] Martin J. S. Rudwick, *The Great Devonian Controversy: The Shaping of Scientific Knowledge among Gentlemanly Specialists* (Chicago, IL: The University of Chicago Press, 1985), 451-455.

[32] Rudwick, *The Great Devonian Controversy*, 451.

Regardless of the various theories circulating concerning the exact mechanism of change, there was unanimous agreement on the fact that the face of the Earth had undergone dramatic changes and would likely continue to do so in the future. Geologists agreed that the Earth was malleable and had a history.[33] Deep time's reigning kings, Charles Lyell and James Hutton, saw this history as cyclical. Besides the mechanism that brought these changes, the precise time it took for these changes to take place was also in dispute.[34] It is easy to imagine that given the surety of the plastic nature of the Earth and the uncertainty surrounding its mechanism and timescale, a wide variety of science-infused vernacular theories could arise to fill in the gaps. Furthermore, many of the most famous figures of geology instilled their work with spiritual elements and held steadfast to the belief that the earth was made for humanity. This made it easier to embrace humanity's new coal-granted powers to change the world. In a cyclical world dominated by the God-granted human mastery over nature through coal, deep time had no depth.

James Hutton is regularly lauded by historians as the discoverer of deep time.[35] He read *The Sacred Theory* with great interest and subsequently sought to supersede

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[33] Martin Rudwick's two-volume history of geohistory is unparalleled in its coverage.; Rudwick, *Bursting the Limits of Time.*; Rudwick, *Worlds before Adam.*

[34] It took the use of radiometric dating pioneered in the early twentieth century to impose precise chronologies on the Earth's strata. However, Kenneth L. Taylor maintains that Rudwick's analysis seems to indicate that "from the 1840s forward it becomes increasingly problematic to maintain a separation of geohistorical from causal or geodynamical issues."; Kenneth L. Taylor, "The Establishment of Geohistory," *Isis* 100, no. 4 (2009): 875.

[35] For examples of Hutton's heroic treatment in history, see: Archibald Geikie, *The Founders of Geology*. 2nd ed. (New York: Dover Publications, 1897).; Karl Alfred Von Zittel, *History of Geology and Palaeontology to the End of the Nineteenth Century*, Trans. Maria M. Ogilvie-Gordon (New York: Charles Scribner's Sons, 1901).; For modern historical analyses of Hutton, see: Baxter, *Ages in Chaos*.; Gould, *Time's Arrow, Time's Cycle*, 64.; Greene, *Geology in the Nineteenth Century*, 19-22.; Repcheck, *The Man Who Found Time*.; Though it is important to point out that deep time was not really a new concept or Hutton's sole contribution.; Greene, *Geology in the Nineteenth Century*, 30; Rudwick, *Bursting the Limits of Time*, 169.

Burnet's biblically-based theory.[36] For Hutton, it would seem Burnet's work served a similar function as *Vestiges* did for Charles Darwin.[37] *The Sacred Theory* was a popular work that, while intriguing and engaging, was deeply problematic. It was a cautionary tale to others who wished to construct more serious scholarship concerning the history of the Earth. Hutton's first publication concerned the classification of coal for commercial purposes, but he is most famous for his 1795 *Theory of the Earth*.[38] In it, he wrote the phrase inscribed in stone for all geologists: "But if the succession of worlds is established in the system of nature, it is in vain to look for any thing higher in the origin of the earth. The result, therefore, of this physical inquiry is, that we find no vestige of a beginning, – no prospect of an end."[39] With those words he stirred future geologic imaginings and angered those searching for earth's beginning.[40] However, it took John Playfair's 1802 popularization of Hutton's work for his theories to cause a stir among a wider audience.[41] Nevertheless, Hutton was conventional in the sense that he held on to a deist's understanding of the Earth's history that favored a cyclical and continuous condition of habitability.[42] Hutton was a farmer before a natural historian and recognized the necessity

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[36] Baxter, *Ages in Chaos*, 51.; For a study of the lineage of ideas that led to Hutton and his significance, see: Giorgio Ranalli, "Robert Hooke and the Huttonian Theory." *The Journal of Geology* 90, no. 3 (1982): 319-325.
[37] James A. Secord, *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of Vestiges of the Natural History of Creation* (Chicago, IL: University of Chicago Press, 2003).
[38] Cutler J. Cleveland, *Concise Encyclopedia of the History of Energy* (San Diego, CA: Elsevier Inc., 2009), 6.
[39] James Hutton, *Theory of the Earth* Vol. 1 (Edinburgh, 1795).
[40] One of his most vocal critics Richard Kirwan attacked Hutton for denying earth's origins and thought his theory of coal formation from plant matter was foolish.; Carroll Lane Fenton, *Giants of Geology* (Garden City, NY: Doubleday, 1952), 54-55.; Gillispie, *Genesis and Geology*, 46-66.; Ralph O'Connor, *The Earth on Show: Fossils and the Poetics of Popular Science, 1802-1856* (Chicago, IL: The University of Chicago Press, 2007), 17, 56
[41] Fenton, *Giants of Geology*, 59-60.
[42] Gould, *Time's Arrow, Time's Cycle*, 74.; Laudan, *From Mineralogy to Geology*, 115-116.; Rossi, *The Dark Abyss of Time*, 117-118.; Rudwick, *Bursting the Limits of Time*, 158-172.

of rich soil for making Earth a habitable home for humanity.[43] By insisting on this cyclical pattern of Earth's history, Hutton actually denied the importance of time itself.[44] The earth was under humanity's dominion and the geologic processes of renewal would have to favor this power.

Charles Lyell, the man credited with the theory of uniformitarianism, sought to expand and refine Hutton's theory of deep time and the mechanisms driving geological history.[45] Lyell published the first volume of his *Principles of Geology* in 1830 and demonstrated his belief in the immense spans of time required for geologic change. Lyell's *Principles* detailed an argument or "strategy" for a non-directional, uniformitarian method for comprehending the history of the earth.[46] He proclaimed, "[t]he renovating as well as the destroying causes are unceasingly at work, the repair of land being as constant as its decay."[47] Lyell sought not simply to describe the past or even attempt to determine the origins of the Earth, but to provide a mechanism for the Earth's geological processes.[48] He regarded the use of the Bible to bolster geological theory, the search for

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[43] Gould, *Time's Arrow, Time's Cycle*, 76-77.
[44] Gould maintains that Hutton denies history, but history was and is often understood as cyclical. Gould prioritizes directionality and progress in historical narrative and sees that Hutton has overwhelmingly rejected a progress narrative. Yet, there was a stream of directionality to Hutton's work in prioritizing humanity's dominion over nature and the need for the world to achieve a steady state that favored conditions amenable to human life and by extension agriculture. What Hutton in fact denied was the need for time. Process, and therefore a traditional sense of time, could be separated from the history seen in the strata.; Gould, *Time's Arrow, Time's Cycle*, 80-91.; Rudwick also argued a similar point.; Rudwick, *Bursting the Limits of Time*, 172.
[45] Lyell's theory was later termed "uniformitarian" by William Whewell.; Rudwick, *Worlds before Adam*, 358.; Greene, *Geology in the Nineteenth Century*, 72.; Lyell critiques Hutton's methods in the beginning of his *Principles*.; Charles Lyell, *Principles of Geology: Being an Attempt to Explain the Former Changes of the Earth's Surface, by Reference to Causes Now in Operation.* 3 Vols. Vol. 1 (London: John Murray, Albemarle Street, 1830). Ch. 4, 5.
[46] Rudwick, *Worlds before Adam*, 297-389.; Martin J. S. Rudwick, "The Strategy of Lyell's Principles of Geology," *Isis* 61, no. 1 (1970): 5-8.
[47] Lyell, *Principles of Geology*, Vol. 1, 473.
[48] Rudwick, "The Strategy of Lyell's Principles of Geology," 8-9.

origins, the dismissal of deep time, and the use of catastrophic events, as characteristics of poorly performed geology.[49] Lyell struck hard at the scriptural geologists of his time and sought to revise the nature of geological reasoning.[50]

Coal was central to Lyell's science. It not only allowed him to travel and distribute his ideas, but it also provided evidence for his theories. Coal played a key role in his deconstruction of the theory that Earth's history was leading in a specific direction. Due to its relevance to industrial society, coal was a relic of the deep past that many persons were intimately familiar with and it was a subject of intense study. Those of a directionalist orientation (believing that the Earth's history was headed in a particular direction) assumed that fossilized flora found in temperate or artic regions (most often in coal seams) that had tropical analogs in the present were signs of a cooling planet.[51] In his chapter VIII, Lyell used the coal-bearing Carboniferous Period as an example for reasoning against directional theories for a cooling earth.[52] Using fossils as his guide, he determined that the climate would circulate around a certain mean and was dependent on other factors such as the distribution of land and sea.[53] Climates would not change rapidly because the globe would not change over "the course of a few thousand years." Yet, since he was living in a Carboniferously-charged world, Lyell suggested that the

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[49] Rudwick, "The Strategy of Lyell's Principles of Geology," 10.; Gillispie, *Genesis and Geology*, 121-148.; Lyell had also earlier discussed the improper use of scripture in evaluating the history of the earth.; Charles Lyell, "Scrope's Geology of Central France," *The Quarterly Review* 36 (1827): 476-477, 481-483.
[50] For biographical work on Lyell, see: Leonard G. Wilson, *Charles Lyell, the Years to 1841: The Revolution in Geology* (New Haven, CT: Yale University Press, 1972).; Leonard G. Wilson, *Lyell in America: Transatlantic Geology, 1841-1853* (Baltimore, MD: Johns Hopkins University Press, 1998).; Leonard G. Wilson, "Geology on the Eve of Charles Lyell's First Visit to America, 1841," *Proceedings of the American Philosophical Society* 124, no. 3 (1980): 168-202.
[51] Rudwick, "The Strategy of Lyell's Principles of Geology," 12
[52] Rudwick, "The Strategy of Lyell's Principles of Geology," 13-14.; Lyell, *Principles of Geology*, Vol. 1, 125-126.
[53] Lyell, *Principles of Geology*, Vol. 1, 127.

actions of humans may be "exceptions to this rule" through the destruction of forests and draining of wetlands.[54] Furthermore, given the cyclical nature of the Earth's climate, Lyell imagined that creatures resembling those only known through their fossilized remains may again roam the world in the distant future. "The huge iguanodon might reappear in the woods, and the ichthyosaur in the sea," Lyell mused, "while the pterodactyle might flit again through umbrageous groves of tree-ferns."[55] In the coal-fueled future, it was anybody's guess what the Earth would look like.

Recognizing the Earth's history as revealed in the strata was a necessary precondition for accepting the long geologic timescales that Hutton and Lyell pondered. Because humans are not able to observe the changes taking place that take geologic spans of time, change over time was recognized before it was understood how long those actual changes took. It had to be observed after the fact, and therefore, measures of time came later.[56]

The coincidence of the development of Hutton's theory of deep time with the English Industrial Revolution is not accidental.[57] Geology was both important in terms of its economic contribution to society and in granting a wider perspective on the natural

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[54] Lyell, *Principles of Geology*, Vol. 1, 124.
[55] Lyell, *Principles of Geology*, Vol. 1, 123.; For an exploration of the art produced by one of his critics and how it reflected opposition to Lyell's statement that the future may see a return of the extinct species we now find enthroned in rock, see: Martin J. S. Rudwick, "Caricature as a Source for the History of Science: De La Beche's Anti-Lyellian Sketches of 1831," *Isis* 66, no. 4 (1975): 534-560.; For a discussion of Lyell's cyclical geohistory, see: Gould, *Time's Arrow, Time's Cycle*, 99-179.
[56] Another figure who fits into this fusion of dating the earth's age and the fusion of religion and science is Lord Kelvin. It has been argued that his estimates for the earth's age were limited by his religious beliefs. See: Leonard Wilson, "Religious Assumptions in Lord Kelvin's Estimates of the Earth's Age," *Earth Sciences History* 29, no. 2 (12/01/2010): 187-212.
[57] E. A. Wrigley, *Continuity, Chance and Change: The Character of the Industrial Revolution in England* (New York: Cambridge University Press, 1988).

history of the planet.[58] Similarly, the "time revolution" of the mid nineteenth century coincided with the start of the explosive growth of the United States through industrialization after the Civil War. The fast pace of industrial life and the explosion of information circulating in society made it more imperative that humanity find its place in the wider cosmos. The rising authority of science and the interest in obtaining metals and fossil fuels for industrial processes fed a distancing of humanity from the natural world. Humanity had become a force of nature through coal. In this context, there could be geological history without deep time. Geologists recognized the historical nature of their enterprise and its importance in finding a place for humanity in this tumultuous time. Life was no longer static; it exhibited an exhilarating change over time. Exactly how long change took place in the history of the earth was unclear, but it was evident that one could read the history of the earth through the lens of geology and that for many individuals religion had a role to play in interpreting this history. Coal was a key player in this drama.

Coal's Divine Qualities: The Progress of Ages

Throughout the nineteenth century the American Association for the Advancement of Science (AAAS) allowed the presence of religion in scientific discourse. However, while they allowed a wide variety of perspectives in their speaking engagements, the AAAS officials filtered what they published in their official documents

[58] Rudwick, *The Great Devonian Controversy*, 3-4.; Paul Lucier, *Scientists & Swindlers: Consulting on Coal and Oil in America, 1820-1890* (Baltimore, MD: The Johns Hopkins University Press, 2008).

so as to lean towards scientific secularism.[59] This makes it seem as though science was in the process of distancing itself from religion and that the experts in leadership positions within America's scientific community did not hold religious beliefs in conjunction with their science. Theology, however, infused the science of many experts during this period. As realms of science began to become distinct from each other at the end of the nineteenth century, the terrain of religion became more distinct from science. However, it must be remembered that this separation into non-overlapping cultural realms is not the full story, and science at the start of the twentieth century cannot be thought of as isolated from cultural influences and religious ideology.[60]

Prior to the Civil War, a significant proportion of geologists were trained in theology and sought to reconcile their beliefs with what they observed in the earth. Geology was therefore influenced by theology and this was reflected in the texts that they produced. As the century was spent, the religious element of natural history and theology was in part excised from science in the arena of geology through the study of the development and history of the earth and its species in the fossil record.[61] But as can be seen in the work of Edward Hitchcock, J. W. Dawson, and James Dwight Dana, religion and geology were united and overlapping in the minds of influential geologists from the

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[59] Sally Gregory Kohlstedt, Michael M. Sokal, and Bruce V. Lewenstein, *The Establishment of Science in America: 150 Years of the American Association for the Advancement of Science* (New Jersey: Rutgers University Press, 1999), 45.

[60] This is what Stephen Jay Gould has termed the nature of "non-overlapping magisterial." However, I disagree that they could not overlap because there is clear evidence of science and religion being intertwined.; Stephen Jay Gould, *Rocks of Ages: Science and Religion in the Fullness of Life* (New York: Ballantine Pub. Group, 1999).

[61] Richard Paul Boekenkamp, "Geological Education in the United States During the Late Nineteenth Century" (PhD diss., Ohio State University, 1974), 9, 54.; Robert V. Bruce, *The Launching of Modern American Science, 1846-1876* (Ithaca, NY: Cornell University Press, 1987), 120-127.

mid-to-late nineteenth century.[62] Some used the Bible and Christianity's canonical texts to inform their science, others were deists that looked instead to nature for signs of God, and many believed in divine Providence.[63] Men interested in mining such as Israel Wistar Morris and Rossiter W. Raymond, also held similar beliefs. Often, regardless of their particular spiritual goals and sentiments, coal played a significant role in how they expressed God's plan in the geological record.

Edward Hitchcock published the text *Elementary Geology* in 1841 for students, the government of Massachusetts, and the public.[64] Hitchcock was a professor of chemistry and natural history at Amherst College, a geologist for the state of Massachusetts, member of the American Philosophical Society, the American Academy of Arts and Sciences, and the Academy of Natural Sciences.[65] He was also a scriptural geologist who used Christianity to inform his science and always considered the economic impact of his field in industrial society.[66] Coal was an important resource; so

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[62] Roy Porter, "Charles Lyell and the Principles of the History of Geology," *The British Journal for the History of Science* 9, no. 2 (1976): 98.

[63] Laudan, *From Mineralogy to Geology*, 115-116.; Gillispie, *Genesis and Geology*, 10.; John M. Lynch ed., *Creationism and Scriptural Geology, 1817-1857* (Bristol: Thoemmes Press, 2002).

[64] Edward Hitchcock, *Elementary Geology* (New York: Dayton and Saxton, 1841), v.; George H. Daniels used the geologist Edward Hitchcock as an example of the transition where "the term 'popularizer' began to be used more frequently and to take on its more modern invidious connotation. Popular lecturers generally abandoned the old effort to convey up-to-date scientific understanding, contending themselves instead with retailing 'wonders'."; George H. Daniels, *American Science in the Age of Jackson* (New York: Columbia University Press, 1968), 40.

[65] For an autobiography of Hitchcock, see: Edward Hitchcock, *Reminiscences of Amherst College Historical, Scientific, Biographical and Autobiographical: Also, of Other and Wider Life Experiences* (Northampton, MA: Bridgman & Childs, 1863).

[66] Bruce, *The Launching of Modern American Science*, 122, 167.; J. David Archibald, "Edward Hitchcock's Pre-Darwinian (1840) 'Tree of Life'," *Journal of the History of Biology* 42, no. 3 (2009): 561-592.; Stanley M. Guralnick, "Geology and Religion before Darwin: The Case of Edward Hitchcock, Theologian and Geologist (1793-1864)," *Isis* 63, no. 4 (1972): 529-543.; Philip J. Lawrence, "Edward Hitchcock: The Christian Geologist," *Proceedings of the American Philosophical Society* 116, no. 1 (1972): 21-34.; Hitchcock was not alone in this endeavor and a number of individuals continued to pursue the unification of geology and the Bible. These individuals were often referred to as "scriptural geologists" or "Mosaic geologists." For examples, see: Joseph Baylee, *Genesis and Geology: The Holy Word of God Defended*

much so that it was God's will that it was readily available for humans to use. The depositional arrangement of coal, "facilitates the exploration and working of coal" Hitchcock wrote, and "we can hardly doubt but it is the result of Divine Benevolence."[67] Under a section titled "Proofs of Divine Benevolence," Hitchcock stated as proof number 8, the earth "was covered with a gigantic vegetation, whose relics became entombed, and were gradually converted to those beds of coal, which are now in the course of disinterment, and which are so important to human improvement and happiness."[68] In relation to the determination of humanity's place in geologic history, Hitchcock believed that the Bible would be the key and understood it to be "very recent, and one of the last displays of creative energy witnessed on earth."[69] Time was long for Hitchcock, but humanity was the culmination of the eons.

In reference to Hutton and deep time, Hitchcock repeated Hutton's famous phrase, "in these changes he sees 'no traces of a beginning, no prospect of an end.'"[70] However, he noted that Playfair, Hutton's popularizer, "show[ed] that Hutton did not mean by such language that the world is eternal: but only that geology, like astronomy, does not disclose to us the time when this series of changes commenced."[71] Hitchcock did not believe in "the doctrine which maintains that the operations of nature have

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from Its Assailants (London: Adam Holden, 1857).; Denis Crofton, *Genesis and Geology: Or, an Investigation into the Reconciliation of the Modern Doctrines of Geology with the Declarations of Scripture*. London, Wertheim and Macintosh, 1857).; William Denton, *Irreconcilable Records: Or, Genesis & Geology* (Boston: William Denton, 1872).; Nicholas Collin Hughes, *Genesis and Geology, the Harmony of the Scriptural and Geological Records* (Chocowinity, NC: The author, 1887).; Joseph P. Thompson, *Man in Genesis and in Geology: Or, the Biblical Account of Man's Creation, Tested by Scientific Theories of His Origin and Antiquity* (New York: Samuel R. Wells, 1870).

[67] Hitchcock, *Elementary Geology*, 49.
[68] Hitchcock, *Elementary Geology*, 279.
[69] Hitchcock, *Elementary Geology*, 99-100.
[70] Hitchcock, *Elementary Geology*, 297.
[71] Hitchcock, *Elementary Geology*, 297.

proceeded eternally as they now do, and that it is unnecessary to call in the agency of the Deity to explain natural phenomena."[72] Matter may be eternal, but God was responsible for the actions that represent Earth's history.

Hitchcock followed up his 1841 textbook with *The Religion of Geology* in 1851. Here he debated Burnet's biblical inaccuracies and once again spoke of the benevolence of God as revealed in the geologic record.[73] This time coal was proof number 7, and Hitchcock dove into an imaginative trip through time to explain why God would have allowed for the extravagance of lush forests at a time when they could not be exploited or enjoyed by humanity. He began with a bit of time travel imagery and invited his audience to consider "[i]f a created and intelligent being from some other sphere had alighted on this globe during that remote period when the vegetation now dug out of the coal formation covered the surface with its gigantic growth, he might have felt as if here was a waste of creative power." The gigantic and lush "forests of sigillaria, lepidodendra, coniferae, cycadeae, and tree ferns would have waved over his head" and he would have inevitably asked, why "is there such a profusion of vegetable forms, and such a colossal development of individual plants? To what use can such vast forests be applied?" Hitchcock's answer lay in the passage of time. Industrial Britain's coal-fueled steam engines that were "performing the work of two millions of men, and moving machinery which accomplishes what would require the unaided labors of three or four hundred millions of men" illustrated the utility of this ancient foliage. Furthermore, in the United States,

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[72] Hitchcock, *Elementary Geology*, 275.
[73] Edward Hitchcock, *The Religion of Geology and Its Connected Sciences* (Boston, MA: Phillips, Sampson, and Company, 1851). 114.

> stretching over one hundred and fifty thousand square miles, containing a quantity absolutely inexhaustible, and already imparting comfort to millions of the inhabitants, and giving life and energy to every variety of manufacture through the almost entire length of this country, and destined to pour out their wealth through all coming time, long after the forests shall all have been levelled, - and irresistible must be the conviction upon his mind, that here is a beautiful example of the prospective benevolence on the part of the Deity.[74]

Hitchcock's "Deity" was not one to waste his energies. All that God created would, in time, serve human needs and desires. Collapsing the seemingly vast gulf between deep time and the human present, Hitchcock argued that God had long ago begun the painfully slow process of creating coal so that it would be perfectly timed to fuel American industrialization in the nineteenth century. To the secular mind, coal might appear to be an ancient artifact of entirely non-human origins, yet in God's infinite wisdom the coal contained a human purpose from its vegetative beginnings. Coal, was not only recognized for its ancient character by Hitchcock, he believed it to be so useful to humanity that it was clearly a gift of God that would ensure human comfort forever.[75]

Hitchcock was not alone in viewing coal as a gift from on high. In *The Story of the Earth and Man* (1873) by J. W. Dawson, a geologist, principle, and vice-chancellor of McGill University, he called upon deistic natural history and stated that geology "invites us…to enter into the very workshop of the Creator."[76] Dawson treated the formation and nature of coal directly in reference to the Carboniferous system. He began his chapter on

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[74] Hitchcock, *The Religion of* Geology, 210-211.
[75] For other examples of theistic references in geology textbooks, see: David Page, *Advanced Text-Book of Geology: Descriptive and Industrial* (London: William Blackwood and Sons, 1856), 2, 5, 280, 299.; Archibald Geikie, *Elementary Lessons in Physical Geography* (New York: Macmillan and Co., 1877), 366.
[76] J. W. Dawson, *The Story of the Earth and Man* (Toronto, CA: Copp Clark & Co., 1873), vii.

the "Carboniferous Age" by stating, "[t]hat age of the world's history which, from its richness in accumulations of vegetable matter destined to be converted into coal, has been named the Carboniferous, is in relation to living beings the most complete and noble of the Paleozoic periods."[77] Nature, or more precisely "the Supreme Creative Spirit," Dawson believed,

> has kept her beds of coal for millions of years without being able to find much use for them…there was no living thing on the face of the earth that could see any sort of value in them; and it was only the other day, so to speak, that she turned a new creature out of her workshop, who by degrees acquired sufficient wits to make a fire, and then to discover that the black rock would burn.[78]

His sentiments mirror those of Hitchcock in 1851. The importance of the Carboniferous was reflected in Dawson's statement that, "[i]n the present condition of our civilization, coal is the most important product which the bowels of the earth can afford to man."[79]

A final example of the deistic tendency of a number of prominent geologists is James Dwight Dana who composed textbooks such as the *Manual of Mineralogy and Petrography* (1898, 12th Edition) and *Manual of Geology* (1863) that were bestselling and widely used in college courses throughout the late nineteenth century.[80] In 1895, a former student of his stated, "[t]o sit at the feet of Professor Dana and drink from the overflowing fountains of his knowledge, was a privilege which once enjoyed could never

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[77] Dawson, *The Story of the Earth and Man*, 109.; The very name "Carboniferous" for the period where humans find coal is a reflection of science's cultural nature. There could have been any number of terms used to define this period, but the fact that it was labeled when coal was of immense use to western society secured its title as the coal-bearing period.

[78] Dawson, *The Story of the Earth and Man*, 133-135.

[79] It is also of note that Dawson did not regard the "evolutionists" highly. He believed in the "rational superiority of man" and stated "[s]have and paint your ape as you may, clothe him and set him up upon his feet, still he fails greatly of the 'human form divine.'"; Dawson, *The Story of the Earth and Man*,116, 394-395.

[80] Bruce, *The Launching of Modern American Science*, 44, 99, 139, 285.

be forgotten."[81] Dana's purpose for pursuing and publishing a geological manual was illustrated in the preface to his 1863 *Manual of Geology*. There he stated, "[g]eology is rapidly taking its place as an introduction to the higher history of man. If the author has sought to exalt a favorite science, it has been with the desire, that man—in which geological history has had its consummation, the prophesies of the successive ages their fulfillment—might better comprehend his own nobility and the true purpose of his existence."[82] Deism infused Dana's approach to geology and he believed that the "Infinite Mind" was guiding creation and geological processes "towards the great end."[83] Geology did not just pertain to the study of rock formations but also "the history of life on the globe," which "adds tenfold interest to the other records of the dead rocks."[84] The approach to geology that Dana favored was "using the present in order to reveal the past," assuming "that the forces in the world are essentially the same through all time."[85] Here Dana supported a uniformitarian view and saw that time was no trivial matter. Geology was unable to make precise estimates of time according to Dana, but "it affords facts sufficient to prove the general proposition that Time is long."[86] To which he later added, "Time is long, - very long."[87]

Yet, even if time was long, the earth was made by God for humanity in Dana's eyes. Dana concluded,

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[81] Oliver C. Farrington, "James D. Dana as a Teach of Geology," *The Journal of Geology*, Vol. 3, No. 3 (Apr.- May, 1895), 335.
[82] James Dwight Dana, *Manual of Geology: Treating the Principles of the Science with Special Reference to American Geological History, for the use of Colleges, Academies, and Schools of Science* (Philadelphia, PA: Theodore Bliss & Co., 1863), ix.
[83] Dana, *Manual of Geology*, 1, 601-602.
[84] Dana, *Manual of Geology*, 5.
[85] Dana, *Manual of Geology*, 7.
[86] Dana, *Manual of Geology*, 590.
[87] Dana, *Manual of Geology*, 591.

> [g]eology appears to bring us directly before the Creator; and while opening to us the methods through which the forces of nature have accomplished His purpose, - while proving that there has been a plan glorious in its scheme and perfect in system, progressing through unmeasured ages and looking ever towards Man and a spiritual end, - it leads to no other solution of the great problem of creation, whether of kinds of matter or of species of life, than this: - Deus Fecit.[88]

"God made" the entire planet's history was directed by God and humanity was the culmination of the long march of time.

This was not solely the vision of geologists, but also of those employed in mining and generally interested in the natural history of the earth. The vital role that coal was playing and would continue to play into the nation's future was addressed by Israel Wistar Morris in his 1872 text, *The Duty on Coal*. Morris was a mining engineer and coal expert from Philadelphia who, according to his obituary, "before the outbreak of the Civil War…was engaged in anthracite mining…in a period when the use of anthracite for domestic purposes was practically unknown. Following the Civil War he became identified with several coal companies and made a fortune."[89] He was also a member of the American Institute of Mining Engineers and the American Philosophical Society, was the president of Locust Mountain Coal Company, and assisted in the creation of the Lehigh Valley Railroad.[90] From the start of his treatise on coal, Morris emphasized the providential nature of coal and its energizing association with industrial civilization:

> The production and consumption of fuel in any country may be taken as a fair measure of its manufacturing

[88] The Latin here translates to "God made it."; Dana, *Manual of Geology*, 602.
[89] "Obituary: Israel Wistar Morris," *Colliery Engineer*, no. v. 30 (1910): 441.
[90] American Institute of Mining Engineers, "Obituary: Israel Wistar Morris," *Engineering and Mining Journal*, no. v. 88 (1909).

> prosperity, and even of its civilization; for it is well known that as mankind advance in knowledge, their increased wants demand the increased use of heat.[91]

Morris recognized that the ever-increasing need to draw upon more heat required that humans "must have a more bounteous supply than can be furnished from" forests.[92] It was in the wisdom of God that coal was placed below the surface of America:

> An all-wise Creator, with his infallible wisdom, foresaw this, and placed under the earth's crust, and yet within the reach of man, a bountiful supply of mineral fuel known by the generic name of *Coal*…The present generation is indebted to coal to a vastly greater extent than they have been in the habit of admitting…While England possesses only 8500 square miles of coal-bearing country, an all-wise Creator has foreshadowed the future greatness of the United States by bestowing upon us a coal-bearing area which extends over 600,000 square miles of territory.[93]

It was not simply geologic processes that produced the vast stores of coal in North America, but also God's faith in the greatness of the United States. Morris' thoughts are no aberration or uniquely his own. The United States Commissioner of Mining Statistics, Rossiter W. Raymond, also wrote in 1872:

> If any material thing may stand as a type of force, it is coal, the deposits of which may well be called vast storehouses of power – the product of solar activity through uncounted years – laid up for the use of man; and iron, on the other hand, may symbolize the inert, dead matter, awaiting the touch of power to wake it into efficient life. These are prime elements in our universe of industry. Take them away and our present civilization is annihilated. Put them together in the hand of an intelligent and mighty nation, and that nation could recall the world from the chaos of

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[91] Israel Wistar Morris, *The Duty on Coal: Being a Few Facts Connected with the Coal Question, Which Will Furnish Matter for Thought to the Friends of American Industry* (Philadelphia, PA: Henry Carey Baird, 1872), 3.
[92] Morris, *The Duty on Coal*, 3.
[93] Morris, *The Duty on Coal*, 3-4.

> barbarism. But they need each other, and it is in the wonderful combination of both, as well as the exhaustless abundance of each, that America finds sure promise of enduring power.
>
> Thus East and West bear witness of our great inheritance of natural wealth. Every period of geological change has been laid under contribution to endow with rich legacies some portion of our land. Our territory epitomizes the processes of all time, and their useful results to man.[94]

Both Raymond and Morris shared the materialist vision of coal as a geological gift endowed to American industrial society that assured the nation's success in its divine mission.

Coal was such a wonderful substance that provided material abundance and freedom from drudgery (for a fortunate segment of the population), that it was undoubtedly godly. A number of geologists understood the Earth's history as directed by the hand of the Almighty and saw coal as a gift for His chosen people. They were not alone. Men engaged in mining also saw God in the black rock. For the enlightened observer, the deity's designs for humanity could be read in the stratified layers of the geological record. Americans studied the nature of coal and found not only proof of divine benevolence but also evidence of a changing world. Next, I will demonstrate the significance of geology as an American science and how coal helped to begin constructing visions of ancient environments for a wide audience. Coal began to provide the vision for a malleable West as it was providing the means to make the West fulfill the aspirations of Americans.

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[94] United States. Dept. of the Treasury and R.W. Raymond, *Statistics of Mines and Mining in the States and Territories West of the Rocky Mountains: Being the [1st-8th] Annual Report of Rossiter W. Raymond, U.S. Commissioner of Mining Statistics* (U.S. Government Printing Office, 1872), 506-507.

Seeing the Past Through Coal: Geology in America and the Changing Earth

For geology, the task of representing itself as a utilitarian science with practical use to society was simple, especially in the case of the mineralized energy that propelled the progress of industrial society—coal.[95] This section will show that coal geology held a prominent position in American society that straddled the line between industry-wedded interested and professedly disinterested science. Due to its importance to an industrializing nation, in Britain and the United States geology was the first scientific field to formalize opportunities and structured curricula in higher education, and create opportunities for funding and careers.[96] Geologists also had ample and lucrative opportunities to become consultants and obtain patronage for their science.[97] This enabled them to produce scientific research and contribute to the expanding reach of industrial capitalism in America. As a result of the coal wealth in America and its value to society, Americans earned a reputation for their abilities as coal geologists.[98] Because there was a lack of adequately educated mining engineers in America, for a time geologists supplied the required knowledge for coal mining operations.[99] Through the

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[95] For their theoretical musings on subject such as the age of the Earth, geologists were often regarded with less esteem. Therefore, geologists often had to work hard at proving their use to those engaged in mining ventures. Similarly, the theoretical knowledge taught to mining engineers could be seen as hifalutin and at times feminine. (Timothy J. LeCain¸ *Mass Destruction: The Men and Giant Mines that Wired America and Scarred the Planet* (New Jersey: Rutgers University Press, 2009), 58.)

[96] Henrika Kuklick and Robert E. Kohler, "Introduction," *Osiris*, 2nd Series, Vol. 11, Science in the Field (1996), 8.; The science of geology was quite popular according to Robert V. Bruce. He stated, "[a] quarter of all DAB scientists active in the period 1846-76 were earth scientists."; Bruce, *The Launching of Modern American Science*, 83-87, 98.

[97] Bruce, *The Launching of Modern American Science*, 139, 141.; Lucier, *Scientists & Swindlers*, 1-3.

[98] Lucier, *Scientists & Swindlers*, 103, 105, 109, 322, 324.

[99] Lucier, *Scientists & Swindlers*, 108.; Often, miners and mining engineers did not listen to geologists and their practice suffered. There was, however, formal education available for mining engineers which

academic texts of geologists Edward Hitchcock, David Page, James Dwight Dana, Archibald Geikie, Joseph LeConte, and the mining manuals of W. Wardle, Magnus Colbjørn Ihlseng, Herbert Hughes, and George Kerr, this section will illustrate the nature of coal formation and the role that fossils played in conceptualizing coal's origins and significance.

There is an inherent tension within this context since, during the late nineteenth-century, elite American scientists advocated for the essential purity and disinterestedness of science.[100] Professionalization, specialization, and gate-keeping are the terms typically used to describe the process in which men of science in America attempted to regulate and institutionalize their work. Many historians of science have lamented the inherent difficulty in defining and generalizing the process of specialization or professionalization that occurred during the mid-to-late nineteenth century. [101] Putting aside debates concerning the historical accuracy of terminology regarding specialization in science in the late-nineteenth century, there is no doubt that something was happening that warrants explanation as Whewell's term "scientist" began to replace "natural philosopher" and "man of science."[102] In the American context, economic interests were particularly important to consider due to democratic ideals and the absence of the

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covered basics of mineralogy and geology as well as the practical elements of the operation of a mine.; Bruce, *The Launching of Modern American Science*, 140, 154, 332.

[100] Bruce, *The Launching of Modern American Science*, 189.

[101] Bruce, *The Launching of Modern American Science*, 150-151.; Nathan Reingold, "Definitions and Speculations: The Professionalization of Science in America in the Nineteenth Century," in *The Pursuit of Knowledge in the Early American Republic: American Scientific Learned Societies from Colonial Times to the Civil War*, eds. Alexandra Oleson and Sanborn C. Brown (Baltimore, MD: The Johns Hopkins University Press, 1976), 34.; For more concerning the problems inherent in the term "professional" see also; Jim Endersby, *Imperial Nature: Joseph Hooker and the Practices of Victorian Science* (Chicago, IL: The University of Chicago Press, 2008), 23.; Paul Lucier, "The Professional and the Scientist in Nineteenth-Century America," *Isis*, Vol. 100 (2009), 705.; Lawrence Veysey, "Who's a Professional? Who Cares?," *Reviews in American History* 3 (December, 1975), 419-423.

[102] Daniels, *American Science in the Age of Jackson*, 38.

Europe's class structure and patronage networks.[103] There was thus an essential tension born out in antebellum American science that extended into science after the Civil War. In the process of attempting to define itself and raise itself up to the level of European science, it had to grapple with the distinctive cultural context that existed in American society.

Governmental and industry patronage had to be pursued because America did not possess the same socio-cultural environment from which science was born abroad. These funding sources were primarily looking for practical and utilitarian science, not basic science. Science essentially had to be remade in America because the ideals of disinterested research had no practical place in society. The concept of "boundary work" was necessary for wrestling with the contradictions inherent in interested parties funding an enterprise founded on ideals of disinterestedness. [104] Up until the late nineteenth century, American science was diffuse and under-specialized, often conducted in haste, and pragmatic.[105] Consequently, the line between science and technology was less stark than in Europe since a utilitarian impulse was characteristic of Americans, and technology was a practical use of science that was elevated to a higher status.[106] Public opinion regarding the practicality of science infused how scientists were perceived, since

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[103] Bruce, *The Launching of Modern American Science*, 35, 42, 36, 251, 261.; Daniels, *American Science in the Age of* Jackson, 12-13, 34-40.; A. Hunter Dupree, *Science in the Federal Government: A History of Policies and Activities* (Baltimore, MD: The Johns Hopkins University Press, 1986), 1-90, 379-381.; Hugh Richard Slotten, *Patronage, Practice, and the Culture of American Science: Alexander Dallas Bache and the U.S. Coast Survey* (New York: Cambridge University Press, 1994), 33.
[104] Slotten, *Patronage, Practice, and the Culture of American Science*, 96.; Daniels, *American Science in the Age of Jackson*, 41.
[105] Bruce, *The Launching of Modern American Science*, 68-74.
[106] Bruce, *The Launching of Modern American Science*, 130, 149.

elite scientists were maligned for their attempted disinterestedness in the 1850s.[107] A field of open access to funding sources through the government and industry permitted a more democratic sphere that had to be policed by credentialed scientists. Amateurs were crucial to the early practice and promotion of science while the public and U.S. government financially supported the nascent American scientific establishment.[108] But as the Smithsonian, and national societies such as the AAAS and the American Philosophical Society (APS) gained prominence, the necessary role of the amateur diminished. [109] Interestingly enough, as another indication of its significance as a science in America, the AAAS had its origins in the American Association of Geologists.[110]

During the early stages of modern American science, the domestic production of scientific texts was minimal and because there was not an international copyright system European works were relied upon and reproduced.[111] The teaching of academic geology only was enhanced with the belated application of the Morrill Land Grant College Act of 1862 following the end of the Civil War and the resulting creation of more institutions of higher education.[112] As American science became specialized and the province of trained experts in the late nineteenth century, universities began to lead the way in providing

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[107] Bruce, *The Launching of Modern American Science*, 81.
[108] Bruce, *The Launching of Modern American Science*, 42.
[109] For a detailed examination of the AAAS, see: Kohlstedt et. al., *The Establishment of Science in America*, 45-51.
[110] Bruce, *The Launching of Modern American* Science, 252-257.; Kohlstedt et. al., *The Establishment of Science in America*, 10-15.; Kirtley F. Mather, "Geology, Geologists, and the AAAS," *Science* 129, no. 3356 (1959): 1106-1111.
[111] Bruce, *The Launching of Modern American* Science, 11, 85.; Boekenkamp, "Geological Education in the United States During the Late Nineteenth Century," 54.; It seems that international copyright did not take hold until the Universal Copyright Convention (UCC), where the U.S. became a member in September 16, 1955. <http://www.copyright.gov/fls/fl100.html>
[112] The teaching of geology began early in the century at Yale in 1802 with Benjamin Silliman under the course offerings of "Chemistry" and "Natural History.; Bruce, *The Launching of Modern American Science*, 330.; Kohlstedt et. al., *The Establishment of Science in America*, 3.; Boekenkamp, "Geological Education in the United States During the Late Nineteenth Century," 1-2, 87.

advanced degrees in geology.[113] This specialization bred specific course offerings in geology and a need for the penultimate token of pedagogy—the textbook.

Industrial revolutions in Europe and America played a vital role in distributing science to scientists, students, and the public. With the help of coal-fueled printing and transportation networks, publishers were able to more quickly produce and distribute scientific works to a wide audience.[114] This meant that scientific knowledge could spread throughout society at a rapid pace and fuse with everyday industrial life. Students of geology also benefitted from this diffusion of knowledge. It may have also served to standardize the texts used for geological education. For example, in geology, the works of James Dwight Dana, Edward Hitchcock, Joseph LeConte, Charles Lyell, and Archibald Geikie were well represented at universities.[115]

The Morrill Act was also sparked a rapid rise in industrial and technical education. In the latter half of the nineteenth century, America had begun to emerge as a

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[113] Boekenkamp, "Geological Education in the United States During the Late Nineteenth Century," 150-151.; Lucier, *Scientists & Swindlers*, 316.

[114] Peter J. Bowler, *Science for All the Popularization of Science in Early Twentieth-Century Britain* (Chicago: University of Chicago Press, 2009).; G. N. Cantor and Sally Shuttleworth, *Science Serialized: Representation of the Sciences in Nineteenth-Century Periodicals*. Dibner Institute Studies in the History of Science and Technology (Cambridge, MA: MIT Press, 2004).; Aileen Fyfe, *Steam-Powered Knowledge: William Chambers and the Business of Publishing, 1820-1860* (Chicago: The University of Chicago Press, 2012).; Bernard Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago, IL: The University of Chicago Press, 2007), 29-30.; Susan Sheets-Pyenson, "Popular Science Periodicals in Paris and London: The Emergence of a Low Scientific Culture, 1820–1875," *Annals of Science* 42, no. 6 (1985/11/01 1985): 549-572.

[115] In Boekenkamp's study of nineteenth century geological education in the United States, he notes that a "prominent" similarity between the educational institutions he examined was "the general use of standard texts and references." Another finding of note was that Boekenkamp concluded, "the kind of geology being taught at various institutions during this period was, in the final analysis, related very closely to the experiences, biases, prejudices, and limitations, of the faculty." Consequently, lineages of knowledge production could quickly become entrenched in an institution and be heavily influenced by the reigning instructor.; Boekenkamp, "Geological Education in the United States During the Late Nineteenth Century," 151.

nation of engineers who were known for their inventiveness and ingenuity.[116] The teaching and practical application of geology into mine engineering was a prominent feature of this other type of learning.[117] Other avenues of technical education also existed, such as the International Correspondence Schools (ICS).[118] Therefore, besides college and university instruction and on-the-job training for mining managers, engineers, and foremen, there existed a widely exploited avenue for coal-specific geological education.

The diversity of individuals studying the nature of coal presents an opportunity to analyze the penetration and translation of academic interpretations and descriptions of coal geology to practical and applied knowledge and technologies of coal acquisition during the period of scientific "professionalization." This dispersal of knowledge was also likely not unidirectional, due to the other important element of coal geology—money. Practical applications of the science of geology were profitable. With money involved, there was incentive to get things right. Consequently, the separation between the knowledge generated in universities was not too distant from the understanding gained by amateur geologists who were not credentialed as scientists. Coal was one the most obvious and ubiquitous signs of geo-environmental change that Americans were exposed to during the nineteenth century. In America's atmosphere of industrial capitalism, there was profit in seeing environmental change in the rocks.[119]

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[116] Boekenkamp, "Geological Education in the United States During the Late Nineteenth Century," 11.
[117] Boekenkamp, "Geological Education in the United States During the Late Nineteenth Century," 79, 100-105.
[118] James D. Watkinson, "'Education for Success': The International Correspondence Schools of Scranton, Pennsylvania," *The Pennsylvania Magazine of History and Biography* 120, no. 4 (Oct., 1996): 348.
[119] The profit of scientific knowledge is directly proportional to the spread of that knowledge and its acceptance.

There were a number of theories that circulated regarding the origins of coal in the mid-to-late nineteenth century.[120] These theories required that one imagine environments and processes long past. They admitted to the dramatic environmental change and masses of vegetative matter required for coal formation. What follows are some examples of how the nature and formation of coal was understood and relayed to readers in both textbooks and mining manuals. What was clear to all was that there was significance to the fossils trapped within the coal bearing strata.[121] For geologists, fossils became guides for dating strata and determining ordered geologic sequences, and stratigraphy became the centerpiece of the science as it came into its modern name geology in the nineteenth century.[122] For example, Archibald Geikie described George Christian Fuchsel as one of the founders of geological succession who as early as 1762, used coal's "exotic plants" as one of his pieces of evidence to describe sequences of stratified rocks.[123] Coal, as discussed below, had certain diagnostic fossils that indicated to geologists and miners that there was once an abundance of vegetation where they were looking. Fossils could also be signs of danger for miners working in seams destabilized by these ancient remains.

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[120] Lucier, *Scientists & Swindlers*, 69-107.; See also, John J. Stevenson, "The Formation of Coal Beds. I. An Historical Summary of Opinion from 1700 to the Present Time," *Proceedings of the American Philosophical Society* 50, no. 198 (Jan.-Apr., 1911): 1-116.

[121] One of the first men to exploit fossil knowledge as it pertains to stratigraphic sequences and put it to use graphically made his money constructing coal canals in Britain. William Smith's seminal map had clear utility to those seeking to exploit resources such as coal. They could use his knowledge to locate areas that were most likely to contain the wealth of the earth.; Rudwick, *Bursting the Limits of Time*, 434-444.; Simon Winchester and Soun Vannithone, *The Map That Changed the World: William Smith and the Birth of Modern Geology* (New York, NY: Perennial, 2002).

[122] Daniels, *American Science in the Age of Jackson*, 38.; Laudan, *From Mineralogy to Geology*, 35, 70-86, 138-179.; Martin J. S. Rudwick, "Minerals, strata and fossils," in *Cultures of Natural History*, ed. N. Jardine, J. A. Secord, and E. C. Spary (New York: Cambridge University Press, 1996), 285.; Rudwick, *The Meaning of Fossils*, 264-266.

[123] Archibald Geikie, *The Founders of Geology*. 2d ed. (New York: Dover Publications, 1897), 98-101.

Edward Hitchcock evaluated the nature of coal in his 1841 textbook. Noting the significant fact that he had drawn from the growing stores of data being gathered concerning America's geology, he stated that this work was "made more American than republications from European writers, by introducing a greater amount of our geology."[124] In relation to coal geology, he described fossils located in coal measures (*Sigillaria* and *Stigmaria*), the types of coal (lignite, bituminous, and anthracite), and the likely formation of coal from buried peat and swamp-like environments [Figure 27].[125]

According to the 1856 textbook by the geologist David Page, the geology of coal began through the estuary and in-situ processes of coal formation. Page stated that coal was "a mass of compressed, altered, and mineralized vegetation."[126] As to the process, Page stated, "whether the plants of which it is composed were drifted down by rivers, and deposited along with layers of mud and sand in estuaries, or whether dense forests and peat-mosses were submerged, and then overlaid by deposits of sand and mud, are the two questions at issue…The fact is, there is truth in both."[127] Coal was clearly evidence of a watery and verdant former environment.[128]

In 1863, James Dwight Dana stated that the fossil flora *Stigmaria* are often found in Carboniferous coal formations.[129] "The abundance of Fossil Plants is the most striking characteristic of the Coal era," he noted, and "[i]n many places there are vegetable

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[124] Hitchcock, *Elementary Geology*, v.
[125] Hitchcock, *Elementary Geology*, 48, 112-113.
[126] Page, *Advanced Text-Book of Geology*, 148.
[127] Page, *Advanced Text-Book of Geology*, 154.
[128] Page also addressed the importance of fossils to the science of geology.; Page, *Advanced Text-Book of Geology*, 23.
[129] Dana, *Manual of Geology*, 326.

remains in the coal itself, such as impressions of the stems of trees, or leaves."[130] Consequently, "the vegetable origin of coal is beyond all reasonable doubt."[131] The process that he presented was one in which "coal making decomposition takes place only under water" and occurred primarily in "marshy regions, or where the relics had been swept off into the waters and had there become buried."[132] The process of coal formation was thus similar to that which Page described—a blend of the in-situ and estuary theories.

In 1882, Archibald Geikie described as in the category of "Carbonaceous" formations, and he stated that those items listed in this category "almost always resulted from the decay and entombment of vegetation on the spot where it grew, sometimes by the drifting of the plants to a distance and their consolidation there."[133] In this text, Geikie supported both the in-situ and estuary theories of coal formation and described coal as consisting of "compressed vegetation."[134] Using the Carboniferous system, he specifically described examples of how each theory was supported by evidence in the geological record.[135] He also stated that fossils were integral to the understanding the geologic past and structuring the geologic record.[136] Geikie was careful to list lignite and anthracite as distinct categories because, as he stated, "[i]t should be remembered that the word coal is rather a popular than a scientific term, being indiscriminately applied to any

[130] Dana, *Manual of Geology*, 328, 332.
[131] Dana, *Manual of Geology*, 359.
[132] Dana, *Manual of Geology*, 361.
[133] Archibald Geikie, *Text-Book of Geology* (London: Macmillan and Co., 1882), 170.
[134] Geikie, *Text-Book of Geology*, 171.
[135] Geikie, *Text-Book of Geology*, 719-722.
[136] Geikie, *Text-Book of Geology*, 620.

mineral substance capable of being used as fuel."[137] In order to be coal in the scientific sense, he argued, it must be of vegetable origin and form through folding, compression and specific processes of chemical alteration that turn wood to coal.[138]

Later, in 1886, when referencing the origins of coal, Geikie's description of coal formation in the Carboniferous aligned with the in-situ or peat-bog theory of coal formation and he stated, "[t]hat the coal-jungles extended into the sea is shown by the coal occurrence of marine shells and other organisms in the coal itself."[139] As can be seen from the definition of coal and illustrations of its formation, fossils were an integral part of imagining the former paleo-environments in which coal begins its development. In describing the process of fossilization Geikie used coal as an example of the usual version of the development of fossils, which he described as "the carbonisation of plants (peat, lignite, coal)."[140]

Lastly, another extensively employed textbook was Joseph LeConte's 1896, *Elements of Geology: A Text-Book for Colleges and for the General Reader*. Situated near the close of the century, LeConte's work was representative of the culmination of American geological knowledge up to that point.[141] Like many of his contemporaries, LeConte sought to reconcile religion and science.[142] His organizing principle in the work

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[137] Geikie, *Text-Book of Geology*, 171.
[138] Geikie, *Text-Book of Geology*, 306.
[139] Archibald Geikie, *Class-Book of Geology* (London: Macmillan and Co., 1886), 228-229, 353.
[140] Geikie, *Class-Book of Geology*, 284.
[141] Review of LeConte's *Elements of* Geology by Chamberlin, T. C. *The Journal of Geology* 4, no. 8 (1896): 972-975.
[142] Joseph LeConte, *Religion and Science a Series of Sunday Lectures on the Relation of Natural and Revealed Religion, or the Truths Revealed in Nature and Scripture* (New York: D. Appleton and Co., 1884).; Joseph LeConte, "A Note on the Religious Significance of Science." *The Monist* 10, no. 2 (1900): 161-166.; John M. Martin, "Joseph Leconte and the Reconciliation of Science and Religion." *The Georgia Review* 18, no. 1 (1964): 78-91.

was his own brand of theistic evolution, which he regarded as "the central idea of the history [of the earth]."[143] The purpose of his textbook was to "present clearly to the thoroughly cultured and intelligent student and reader whatever is best and most interesting in Geological Science," and he "attempted to give a really scientific presentation of all the departments of the wide field of geology, at the same time avoiding too great multiplication of detail."[144] Accordingly, this end-of-the-century treatment, which coincided with a rise in scientific specialization and professionalization, was largely absent deistic explanations for geological phenomena. LeConte "desired to make a work which shall be both interesting and profitable to the intelligent general reader, and at the same time a suitable text-book for the higher classes of our colleges."[145] Dana's manual, according to LeConte was the best for specificity and technical details, while Charles Lyell's work was too segmented in its representation of geology and has only a "*meager*" treatment of American geology. Therefore, LeConte "wish[ed] to fill this gap" that resulted from the predominantly overly specific or elementary textbooks concerning geology and to provide an American element to the science.[146]

LeConte defined geology as "the physical history of the earth and its inhabitants, as recorded in its structure" or "the *history of the evolution of the earth and its inhabitants.*"[147] In reference to coal, he stated, "[t]hat coal is of vegetable origin is now

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[143] Joseph LeConte, *Elements of Geology: A Text-Book for Colleges and for the General Reader* (New York: D. Appleton and Company, 1896), v.; For information on LeConte's life, see: Joseph LeConte and William Dallam Armes, *The Autobiography of Joseph Le Conte* (New York: D. Appleton and Company, 1903).; Lester D. Stephens, *Joseph LeConte: Gentle Prophet of Evolution* (Baton Rouge, LA: Louisiana State University Press, 1982).
[144] LeConte, *Elements of Geology*, iii, iv.
[145] LeConte, *Elements of Geology*, iv.
[146] LeConte, *Elements of Geology*, iv-v.
[147] LeConte, *Elements of Geology*, 1.

no longer doubtful."[148] LeConte mentioned that there were two competing theories for coal formation—the "*Peat-bog theory*" and "the *Estuary or raft theory*."[149] "Recently, however, scientific opinions have converged toward a common belief," LeConte noted, "*Coal has been accumulated by growth of vegetation in situ, as in peat-swamps of the present day*."[150] Evidence for this existed in the fossilized remains contained in the coal measures such as stumps, roots, "stigmaria-roots," and anatomically complete impressions of ancient flora.[151] The importance of fossils to the science of geology lay in their comparison in within and across strata, which according to LeConte, "is by far the *best*, and in *widely separated localities the only*, method of determining the age of rocks."[152]

LeConte recognized the relevance in addressing the economic aspects of coal even in his scientific textbook. When speaking about the thickness of coal seams, he made sure to mention that "[a] workable seam must be at least two feet thick" or it runs the risk of being "too thin to form a good roof or floor."[153] LeConte also noted that, "[i]n no other country are the coalfields so extensive as in the United States," and he went on to list major coal-bearing regions of the country.[154] While the British may be anxious about their stores of coal, "[f]ortunately, our own country [the United States]," according to LeConte, "is supplied with almost inexhaustible stores of this source of industrial

[148] LeConte, *Elements of Geology*, 366.
[149] LeConte, *Elements of Geology*, 387.
[150] LeConte, *Elements of Geology*, 387.
[151] LeConte, *Elements of Geology*, 387-388.
[152] LeConte, *Elements of Geology*, 206.
[153] LeConte, *Elements of Geology*, 363.
[154] LeConte, *Elements of Geology*, 364.

prosperity."[155] Therefore, LeConte was aware of the key role coal was playing in the development of the United States and sought to present not only the scientific characteristics of coal, but also the practical elements of mining the resource from the earth.

Academic texts did not ignore the fact that coal was a vital industrial fuel and that miners were intimately in touch with elements of the nature of coal. For example, coal science, in the view of Page, was not "in a *practical* or *industrial* point of view, of less importance to man."[156] He stated that the "miner cannot proceed a step in safety without the light of geological deduction."[157] Page furthered this by stating, "[i]t is necessary, however, to draw a clear line of distinction between the duties of the practical or consulting geologist, and those, for example of the miner, the engineer, or builder. The one collects facts, and establishes therefrom certain generalizations; the others merely avail themselves of these generalizations, and apply them to their own special requirements."[158] The particular realm of knowledge of the academic geologist was more highly valued by Page because they alone could generate new knowledge to be used later for practical applications. According to Page, the geologist's importance to industry lay in the applied use of their knowledge which could "save much fruitless waste of labour and capital, or, what is often as necessary, to prevent unprincipled gambling and ruinous

[155] LeConte, *Elements of Geology*, 365.
[156] Page, *Advanced Text-Book of Geology*, 6.
[157] Page, *Advanced Text-Book of Geology*, 6.
[158] Page, *Advanced Text-Book of Geology*, 282.

speculation."[159] Page recognized two distinct realms of knowledge, but knew that there was benefit in bridging the gap between them.

> The young explorer should also make the acquaintance of every stone-breaker, quarry man, miner, and mason he meets with; and through the terms 'Metamorphic,' 'Silurian,' 'Devonian,' and the like, may be as High Dutch to their ears, yet, if conversed in their own language, many of them will be fount to afford important information both as to the nature of the rocks, the stratification, the faults, and other particulars of a district.[160]

Yet, accurate and universal terms were of great importance since site specific and slang terms "are wanting in that precision which the advancement of science most imperatively demands."[161]

The description given by Dawson also contained scientific terms along with terminology used by miners to describe coal formations and characteristics.[162] For example, he stated, "[i]n the coal formation in all parts of the world it is not unusual…to find erect trees or stumps of trees, usually Sigillariæ, standing where they grew," and in "some places" fossil stumps "are known to the miners as 'coal pipes,' and are dreaded by them in consequence of the accidents which occur from their suddenly falling after the coal which supported them has been removed."[163] There were real dangers for those unaware of the nature of coal. The practical miner would be sure to recognize these signs of a changed environment if only to keep themselves from being entombed with these ancient remains.

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[159] Page, *Advanced Text-Book of Geology*, 283-284.
[160] Page, *Advanced Text-Book of Geology*, 291-292.
[161] Page, *Advanced Text-Book of Geology*, 146.
[162] Dawson, *The Story of the Earth and Man*, 118.
[163] Dawson, *The Story of the Earth and Man*, 141.

Mining manuals contained much of the same coal-based information as academic texts. The authors of these more specialized and utilitarian texts often deemed it necessary to describe the nature, use and dangers embedded in the coal formation. In 1889, following his definition and explanation of the use of geology, W. Wardle answered the question "[w]hat is coal?" by stating, "[c]oal is the product of the decomposition of vegetable matter, and is composed of those elements which enter into the composition of vegetable organisms, such as carbon, hydrogen and oxygen."[164] He was a mining engineer and certified collier manager in the Aldridge collieries. At eight years old Wardle began his career in the coal mines of England and was intimately familiar with their workings and the nature of the black rock.[165] He furnished proof of the vegetable origin of coal by stating, "we find in the coal measures—as the beds of coal and the intervening shales and sandstones are termed—enough of the remains of the ancient plants to be able to recognise, with some degree of certainty, the forests of the coal period."[166] Wardle admitted that fossils were an important element in the processes of understanding geological formations since each "has its peculiar fossils, [and] a knowledge of them frequently enables us to determine the formation, when we might not otherwise be able to do so."[167] He followed this with reference to specific fossils such as *Stigmaria* and *Sigillaria* and what they would mean geologically if encountered in a bed of coal.[168]

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[164] W. Wardle, *A Comprehensive Reference Book on Practical Coal Mining* (London: W. M. Hutchings, Hutton St., Whitefriars, E. C., 1889), 1-2.
[165] Wardle, *A Comprehensive Reference Book on Practical Coal Mining*, iv.
[166] Wardle, *A Comprehensive Reference Book on Practical Coal Mining*, 18.
[167] Wardle, *A Comprehensive Reference Book on Practical Coal Mining*, 19.
[168] Wardle, *A Comprehensive Reference Book on Practical Coal Mining*, 19-20, 55.

Wardle supported the in situ theory of coal formation by stating, "[t]here is little doubt now in the minds of geologists that coal was at one time on the surface, in the shape of dense forests, with an undergrowth of ferns and mosses, and vast swamps in which a few lizards and fish lived."[169] Referencing the length of time that coal formation took, he stated, "[n]o accurate estimate can be made. It has been conjectured that a period of at least a thousand years must intervene before vegetable matter could accumulate to form a bed of coal one yard thick."[170] Since time may be in fact relative, for Wardle, this was perhaps fairly deep time.

In 1892, professor of engineering at the Colorado School of Mines, Dr. Magnus Colbjørn Ihlseng knew of the use of science for mining and consequently addressed some of the particulars of coal-mining as it relates to the science of geology. An example of this was his discussion of fossils. He stated, "[i]n stratified regions the order of the geological series may be observed, and certain fossils furnish the guide."[171] Knowledge of fossils was useful not only for delineating stratification and understanding geologic series, but also due to their impact on the practice of mining. The fossil *Sigillaria*, according to Ihlseng, was responsible for mining accidents involving roof collapse. He stated, "[h]orses, sigillaria, balls of ironstone, rock creviced naturally or by excessive blasting, are threatening conditions that demand a liberal supply of precautionary timbers or filling placed."[172] Fossils served as a good illustration of how Ihlseng utilized science

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[169] Wardle, *A Comprehensive Reference Book on Practical Coal Mining*, 17.
[170] Wardle, *A Comprehensive Reference Book on Practical Coal Mining*, 18.; Here, Wardle references a seam in South Staffordshire which is ten yards thick, which would make the coal ten thousand years old.
[171] M. C. Ihlseng, *A Manual of Mining: Based on the Course or Lectures on Mining Delivered at the School of Mines of the State of Colorado* (New York: John Wiley & Sons, 1892), 11.
[172] Ihlseng, *A Manual of* Mining, 224.

throughout his manual. Fossils were geological science directly applied to practical concerns. Miners and prospectors would be familiar with fossils and know that some knowledge of that sphere of geologic science was necessary for successfully executing their respective professions.

Also in 1892, Herbert Hughes wrote that of particular interest to coal mining was "[a] knowledge of the flora of the coal measures [which was] essential to any one searching unknown districts for indications as to coal-bearing rocks."[173] Knowledge of fossils was once again of great importance to mining. When defining the term "fossils," Hughes stated, "[t]he coal measures contain in varied abundance the remains of luxuriant vegetation."[174] Coal itself was "defined as a solid stratified substance, capable of undergoing combustion in contact with oxygen, not containing sufficient earthy impurities to prevent its being applied as a source of heat in furnaces and fireplaces, and varying in color from brown to black."[175] Regarding the formation of coal, Hughes reported that the in situ theory was the most widely held and stated, "[h]owever much geologists may differ as to the question whether coal was formed on the spot on which the forests that produced it grew, or whether it resulted from the accumulation of drift, every one agrees that it results from the decomposition of vegetable matter."[176]

Lastly, in 1900, George Kerr stated, "[t]he formation which has the greatest interest for the coal-miner is the Carboniferous, for it is in this formation that coal is

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[173] Herbert Hughes, *A Text-Book of Coal-Mining: For the Use of Colliery Managers and Others* (London: Charles Griffin & Company, Limited, 1892), 8.
[174] Hughes, *A Text-Book of Coal-Mining*, 7.
[175] Hughes, *A Text-Book of Coal-Mining*, 9.
[176] Hughes, *A Text-Book of Coal-Mining*, 9.

found most abundantly."[177] In this section, he described the strata where coal was typically found in this formation, and he also identified rocks and minerals that were associated with coal such as "sandstones, shale, or blaes—known amongst miners as bind."[178] There were "numerous theories" for the origin of coal according to Kerr.[179] He briefly presented both the drift and in-situ theories of coal formation, but did not regard either as the most widely accepted amongst geologists. Fossils in the strata revealed both the verity of the vegetable character of coal and the fact that it had its origin in ancient "vast forests" and in particular the fossils "sigillaria or stigmaria, will at once identify the rocks [of the coal-bearing formation]."[180] The definitions of geologic terms that follow were taken from Herbert Hughes, and Archibald Geikie was referenced for further reading.[181] He defined coal with the help of Dr. Percy and Geikie because, he stated, "[c]oal is a substance which it is easier to recognise than to define. Nearly everybody is familiar with the appearance and uses of this common mineral, but its definition is attended with several difficulties."[182] Both definitions agreed that the "varieties of coal have had a common origin; they are all accumulations of ancient vegetation which has undergone chemical change under certain conditions."[183]

Helpful here is Rudwick's claim that geologic knowledge produced during the Devonian controversy was a "social construction that may nonetheless be a reliable

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[177] George L. Kerr, *Practical Coal Mining: A Manual for Managers, Under-Managers, Colliery Managers, and Others* (London: Charles Griffin & Company, Limited, 1900), 5.
[178] Kerr, *Practical Coal Mining*, 5-6.
[179] Kerr, *Practical Coal Mining*, 6.
[180] Kerr, *Practical Coal Mining*, 6, 12.
[181] Kerr, *Practical Coal Mining*, 1-11.
[182] Kerr, *Practical Coal Mining*, 6.
[183] Kerr, *Practical Coal Mining*, 6.

representation of the natural world."[184] Representing the origins and character of the coal has limits since human sensory faculties are essentially standard and coal, as a natural material has a specific character that can be discovered through observation, the aid of technologies, or simply burning it as a source of heat. Its social significance can extend beyond its material nature, but it is nonetheless rooted in its physicality. Geology textbooks and mining manuals placed the primary context of coal production in geologic time during the Carboniferous (though academic geologists admitted to coal being located in a couple of other formations, important to the American West were the Cretaceous and Tertiary), they agreed about the vegetable origin of coal and its process of deposition and generation. The specific fossils found in coal formations were even the same in both genres. Mining engineers and academic geologists agreed that a combination of local knowledge and scientific geologic knowledge was necessary for the proper execution of coal mining. Furthermore, they agreed about the importance and vital nature of coal in a successful and progressive industrial society. The fossils could not be denied as evidence of former forests and there was utility to this material knowledge in profit and in safety.

American science had to be reformulated from its European model. Geology played a significant role in this reformulation as it embodied the line between theory and utility in the industrializing nation. Powering this process was coal. The utility of this energetic resource made it a focus of scientific study. It revealed to its admirers that it was of vegetable origins and geologists sought to determine how it came to be the useful fuel that drove the engines of national prosperity. Mining engineers and foreman also

[184] Rudwick, *The Great Devonian* Controversy, 451.

sought this knowledge in order to effectively exploit this resource. The fossilized flora found in coal made it clear to both audiences that they were seeing the remains of former environments. Coal was a ubiquitous item in industrial America and its origins spoke to the malleability of the earth. Everyone may not have known where coal had come from, but as far as evidence of environmental change it was an easily accessible sign of times past.

Historical Analogy and the Geological Imagination

Geologists sought, above all, to detail the history of the earth.[185] Many of them understood their study of geologic history as similar to the work of historians and were often tempted to unite their nation's history to its geologic past. This endeavor invited deistic orientations since geologists were analyzing nature's history. Their primary referent to method was the field of history that more or less had comprehensible agents of causation. There was so much unknown about earth processes that it was tempting to assign agency to a deity. Forming this analogical relationship produced other results. In comparing the history of the earth with the history of humanity, geologists illustrated the historic nature of the earth and its malleability. As will be demonstrated in later chapters, in the context of the rapidly changing industrial society of America, their analogies suggested to their audience that the history of the earth was also starting to invite rapid change. Through the words of nineteenth-century geologists this section will address the historical character of geology and the requirement for geologists to have powerful

[185] For example, Sir Archibald Geikie stated, "The highest aim of the geologist is to trace the history of the earth."; Geikie, *Class-Book of Geology*, 299.; See also: Robert Frodeman, "Geological reasoning: Geology as an interpretive and historical science," *GSA Bulletin*, August 1995, 107, no. 8: 960-968.

imaginations so that they could gaze deep into the past. These two elements of geological practice invited ample opportunity for cultural intrusions into the history of the Earth.

David Page asked, "if historians are disagreed as to time and incidents so recent, what marvel need it be that geologists are not yet as one respecting events and epochs, compared with which the most distant dates of man are but as the moments of yesterday?"[186] Nevertheless Page held on to hope that it, "is not far distant when the geologist shall be enabled to read the history of the world before man, with as much, if not with greater, certainty than we can now read the phases of human history."[187] LeConte likewise stated, "Geology is essentially a history" and the geologist reads "[t]he leaves of the *book of Time*" that "are scattered hither and thither over the surface of the earth."[188] In geology, just like historical archives, the remains of the past are selective and the gaps must be filled with judgment and interpretation. LeConte believed that "[t]here are certain laws underlying all development – certain general principles common to all history, whether of the individual, the race, or the earth."[189] These would hopefully be discovered and drive human interpretation of the past. Dana described geology as "a historical science" and stated, "geological history is like human history in this respect. Time is one in its course, and all progress is one in plan."[190] However, because geological time was so immense and undetermined at this time, unlike human history, geological history could exist conceptually without a firm knowledge of exact timescales.

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[186] Page, *Advanced Text-Book of Geology*, 267.
[187] Page, *Advanced Text-Book of Geology*, 271.
[188] LeConte, *Elements of Geology*, 205, 290-292.
[189] LeConte so firmly believed in the direct application of history to geology that he made a six-point comparison between geology and history.; LeConte, *Elements of Geology*, 290-292.
[190] Dana, *Manual of Geology*, 4, 125.

To the pragmatist, the question would inevitably arise, could the history of the earth provide insight into the future?[191] Analogy could conceivably slip the other way and one could think not only in terms of how geology is a historical science but how human history could envelop geologic history. Or, how the structures of human time effected how one saw geologic time. The same problem of subjective selection of historical facts that plagues the historian, afflicted those contemplating geological history. The less trained one was to limit the infiltration of bias, the more one would inflect their desires on the interpretation of the past and its implications for the future. Lyell had inflected his view of the history of geology with a catastrophist's bent that favored his views, but he saw the anthropocentric imposition of human desires and fears imposed upon the past and future of the earth as wrongheaded.[192] He recognized that humanity's limited temporal view of geologic processes invited incorrect analogies and that studying "earth's history requires no ordinary share of discretion."[193] Just as Lyell could not escape a subjective approach to human history, many of those that followed Lyell could not wrest themselves free of the grip of anthropocentrism. They saw the history of the earth in direct relation to human history and their cultural imperatives.

Could the warmer climates that yielded large coal seams of America return to the continent? Fossils embedded in coal provided fodder for envisioning this past and imagining the historical environments of North America. Furthermore, if scientists were not wholly secular, could we expect that the American public had eschewed religious

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[191] For a history of pragmatism, see: Louis Menand, *The Metaphysical Club* (New York: Farrar, Straus and Giroux, 2001).
[192] Porter, "Charles Lyell and the Principles of the History of Geology," 93, 98.
[193] Lyell, *Principles of* Geology, Vol. 1, 99.; Though he did use a human constructed structure as his frontispiece as a metaphor and explanation for his theory.

explanations for natural phenomena? The Bible was another source from which to construct a vision of a changing world. Would Eden return? What would it look like? Perhaps fossils would grant insight into Adam and Eve's Eden. Imaginations were set free fueled by fossils and coal. Seeing the earth historically required an uncanny imagination.

As historians of the earth, geologists seek to enter ancient and alien landscapes in order to comprehend the nature of geologic change. For Lyell, this was one of the most powerful gifts that humanity possessed. Change was all around, for anyone to see. Lyell asked, "who can look around them and be witness to all these signs of change, and still contrast the vicissitudes of former ages with the immutable stability of the present order of things."[194] After the gathering of sufficient data from the remains of past times, "the geologist can be enabled to restore to our imagination the picture successively presented at remote periods, by the earth's surface and its inhabitants."[195] Some believed that indulging in the depths of time to be a sign of vanity, according to Lyell, "but the imputation is refuted in the most satisfactory manner by our finding such inexhaustible stores provided by the Author of Nature for the gratification of these intellectual appetencies."[196] The wonders of the ancient past were there for anyone to see and they spoke of changes in the earth. All that one needed was an adequate geological imagination.[197]

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[194] Lyell, "Scrope's Geology of Central France," 472.
[195] Lyell, "Scrope's Geology of Central France," 473.
[196] Lyell, "Scrope's Geology of Central France," 474.
[197] For another exploration of Lyell's imagination and impact, see: O'Connor, *The Earth on Show*, 163-176.

Lyell admitted that when gazing into the deep past it was easy to feel insignificant. The "enlarged conceptions of the earth's antiquity" some claimed denigrated humanity and placed the species among lower animals who were never allowed to "rise beyond the exigencies of the present moment."[198] If seen through this lens, Lyell saw how "all discoveries which extend indefinitely the bounds of time, must cause the generations of man to shrink into insignificance, and to appear, even when all combined, as ephemeral in duration as the insects which live but from the rising and to the setting of the sun."[199] Yet the human mind provided hope for what would have been despair. "But if we hold mind to be something distinct from matter," Lyell explained, "it must be acknowledged that we assert its superiority more clearly by enlarging our dominion over time."[200] Humanity's "progressive power is infinitely enhanced by perceiving what an unlimited field of future observation is unfolded to use by geology, and by its various kindred sciences. Already is our progress accelerated by the mere knowledge that new worlds are accessible to our research."[201] When pondering the wide expanses of time, and "investigating the laws that govern a portion of the universal system, that we exercise our highest prerogative, that of being alone selected to comprehend and admire the works of nature; and when engaged in deciphering the records of that system even at times antecedent to the creation of our race, the soul seems 'unfettered by her gross companion's fall'."[202] Lyell believed in the power of the

[198] Lyell, "Scrope's Geology of Central France," 474.
[199] Lyell, "Scrope's Geology of Central France," 474.
[200] Lyell, "Scrope's Geology of Central France," 474.
[201] Lyell, "Scrope's Geology of Central France," 475.
[202] Lyell, "Scrope's Geology of Central France," 475.

geological imagination and its capacity to elevate humanity beyond its base and minute existence.[203]

Subsequent geologists concurred. There was supreme value in the imagination to the practice of geology. David Page noted in 1856 that the imagination of the geologist took them to far off places in time. "By noting the composition of its rocks, their position and succession, the space over which they spread, and the fossils they contain," Page related to his readers, "the geologist is enabled to indicate the condition and appearance of the world during former epochs."[204] Likewise, Archibald Geikie expressed a similar sentiment in 1886. He confirmed this theory by analyzing stratigraphy, stating, "[t]he whole stratified part of the earth's crust is composed of materials which in this way may be made to tell their story…by the proper use of the imagination, the former conditions of the earth's surface are vividly realised."[205] This ability that geologists crafted could bring them back to the worlds from which coal formed. For example, in 1873, J. W. Dawson took his readers on a trip through time. "[W]e may now transport ourselves into the forests and bogs of the coal formation," Dawson described, "and make acquaintance with this old vegetation, while it still waved its foliage in the breeze and drank in the sunshine

[203] In his *Principles of Geology*, Lyell also expressed that the power of the geological imagination. "The variations in the external configuration of the earth, and the successive changes in the races of animals and plants inhabiting the land and sea, which the geologist beholds when he restores in imagination the scenes presented by certain regions at former periods, are not more full of wonderful or inexplicable phenomena, than are those which a traveller would witness who traversed the globe from pole to pole."; Lyell, *Principles of* Geology, Vol. 1, 159.
[204] Page, *Advanced Text-Book of* Geology, 8.
[205] Geikie, *Class-Book of Geology*, 229.

and showers."[206] The geological imagination functioned analogically and through the use of the material remains found in and on the earth that spoke to these former times.[207]

At the same time that debates were raging about the age of the earth and the mechanisms of change that altered the face of the planet in the past, men of science were verbally and graphically reconstructing the history of the earth. These were not the first men of science to use their imaginations to travel through time. It began with verbal musings in geological treatises in the late eighteenth and early nineteenth century.[208] One of the first visual depictions of deep time soon followed. In 1830, geologist Henry Thomas De la Beche sought to assist his fossil hunting friend Mary Anning during a time of financial difficulty. His gift was an image that penetrated the veil of deep time to depict Anning's fossil finds and promote interest in her research. The painting was titled, *Duria Antiquior*, and it depicted an ancient shoreline replete with abundant ancient life

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[206] Dawson admitted that witnessing the changes that created coal would require a life "far beyond the compass of a life even of a Methuselah."; Dawson, *The Story of the Earth and Man*, 119-120.

[207] A direct example of the analogical reasoning employed by Dawson, for example, was that he noted "the plants and animals, though different, were more like those of the modern South Pacific than any others now living."; Dawson, *The Story of the Earth and Man*, 114.; Furthermore, this is exactly what Lyell's theory of uniformitarianism is based upon. The title of his important work reveals his methods. "*Principles of Geology, Being an Attempt to Explain the Former Changes of the Earth's Surface, by Reference to Causes Now in Operation*." In it, he clearly stated how analogical reasoning would function for his approach to the history of the earth. "For as by studying the external configuration of the existing land and its inhabitants, we may restore in imagination the appearance of the ancient continents which have passed away, so may we obtain from the deposits of ancient seas and lakes an insight into the nature of the subaqueous processes now in operation, and of many forms of organic life, which, though now existing, are veiled from our sight…Thus, although we are mere sojourners on the surface of the planet, chained to a mere point in space, enduring but for a moment of time, the human mind is not only enabled to number worlds beyond the unassisted ken of mortal eye, but to trace the events of indefinite ages before the creation of our race, and is not even withheld from penetrating into the dark secrets of the ocean, or the interior of the solid globe; free, like the spirit which the poet described as animating the universe,— *ire pet omnes Terrasque tractusque maris, cœlumque profundum*."; Lyell, *Principles of Geology*, Vol. 1, 165-166.

[208] O'Connor, *The Earth on Show.*; Martin J. S.Rudwick, "The Emergence of a Visual Language for Geological Science 1760-1840," *Hist. Sci.* xiv (1976): 149-195.

struggling for existence [Figure 28].[209] Fossils found in coal helped to construct more complete visions of past environments. They set the stage for the dramatic encounters envisioned by earth scientists. As we shall see in the following chapters, these visionary trends in time-travel set a precedent for the geologists and paleontologists who entered the arid West and dreamed of verdant and watery paleo-environments. Verbal and visual representations of the paleo-past were constructed and used for seeing the future of the West through its past.

The historical character of geology invited interpretations of the Earth's past that joined human history to that of the planet. It also made it more likely that there would be a search for agents of causation that were comparable to those found in human history. Or, since the history of the planet was an enormous tale that required a potent agent, God was called upon as the protagonist of Earth's story. Biases of historical interpretation would seep into geological science because the fragmentary evidence found in across the globe required extrapolation beyond observed processes and the select remains of ancient organisms. Furthermore, the history of the planet was a huge story to narrate, which entailed weighty cultural and moral implications. To see this history, the geologist's imagination had to be vibrant. Using analogies and metaphors, they were able to reconstruct former worlds using scant material evidence. The moral of the Earth's history, however, was up for grabs.

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[209] Shelley Emling, *The Fossil Hunter: Dinosaurs, Evolution, and the Woman Whose Discoveries Changed the World*, 1st ed. (New York: Palgrave Macmillan, 2009), 141-42.; O'Connor, *The Earth on Show*, 76-77.; Martin J. S. Rudwick, *Scenes from Deep Time: Early Pictorial Representations of the Prehistoric World* (Chicago, IL: The University of Chicago Press, 1992), 42-48.

The Earth Made Malleable:
Human Capacity to Change the Environment

Coal not only provided humans with a window into a former world, it granted physical power. This power gave the geological history of the earth a different spin. If natural forces were manipulating the earth, humans now had the capacity to dominate nature and make it bend to suit their needs and desires. Through the work of five Yorkshire College professors, Svante Arrhenius, Charles Lyell, Archibald Geikie, James Dwight Dana, and Joseph LeConte, this section will reveal how the physical power granted by coal and the atmospheric changes wrought by its combustion made early nineteenth and twentieth-century scientists ponder the dramatic impact of humanity on geological processes and the environment. Just as the diminutive nature of humankind was being unearthed through the study of geological processes, the industrially-augmented might of *Homo sapiens sapiens* made it clear that the species would not be outdone by earth's forces.

Some scientists worried that such an amazing resource would be consumed before it was fully appreciated for its natural character, transformative capacity, and its deleterious social costs. Coal was the key to industrial society, but how much did the public know about it? What was its importance and environmental impact? To answer these questions, in 1877, Professors Green, Miall, Thorpe, Rücker, and Marshall of the Yorkshire College delivered a series of lectures concerning coal in Leeds and Keighley England. The urgency of their lectures can be found in this intriguing passage:

> A generation has passed away since Joule first determined the Mechanical Equivalent of Heat; but the doctrine of the Correlation of Heat and Work has hardly yet come down to

> the popular intelligence: nay, three generations have elapsed since Erasmus Darwin maintained that Coal was formed out of ancient morasses and forests, but what proportion of those who use Coal in these latter days know anything of the mystery of its origin? If the knowledge of these things is in future to spread at no greater rate than this, it is to be feared that our Coal will be at an end before our people have learned to know what it actually is, how it has been formed, and what it can do.[210]

The authors then proceeded to explain the nature of coal much like the above textbooks and mining manuals.[211]The importance of coal to industry and its practical role in society also did not escape the vision of these authors. Coal, according to Professor Rücker, "when employed in the production of heat is popularly regarded as possessing the two-fold character of a source of warmth and a source of power."[212] Because of its wide use, and necessity in industrial society, Professor Marshall addressed the "coal question" concerning the nature of coal as an exhaustible natural resource. For him, "there is no question that for good or evil the prosperity of Great Britain, and with her that of the world of which she is the commercial centre, have become bound up with the uses she has learned to make of the coal she possesses so abundantly."[213]

Marshall also stated, compared to the inevitable dwindling supplies in Britain, "in America practically inexhaustible resources exist."[214] The amazing qualities of coal brought Marshall to the point of making an ahistorical statement about slavery and the use of coal.

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[210] Green, Miall, Thorpe, Rucker, and Marshall, *Coal: Its History and Uses* (London: Macmillan and Co., 1878), vi-vii.
[211] Green et. al., *Coal*, 16-20, 27, 29.; Green references Dr. Dawson and his work regarding the fossil plants of the coal measures.
[212] Green et. al., *Coal*, 224.
[213] Green et. al., *Coal*, 293-294.
[214] Green et. al., *Coal*, 342.

> When we consider that in the coal raised in Great Britain alone in 1876 an amount of energy was contained equal to the labour of more than 3,000,000,000 adult slaves labouring daily throughout the year we may well understand how it is that human slavery has so utterly died out in all civilised, that is, all coal-using, countries since 1778.[215]

Of course, America's "inexhaustible" coal resources certainly did not eliminate human slavery in 1778 – perhaps the authors did not consider the United States to as of yet be a civilized coal-using country. It took close to a century more to have the nation come close to such a proposition, and even then, it required an incredibly bloody war.[216]

Even with knowledge of the exhaustibility of coal, and its impact on human freedom proposed by his colleague, Rücker did not fear the depletion of coal in Britain. His faith in the future was clear when he stated, "should coal fail our descendants as wood fuel threatened to fail our ancestors some three centuries ago, the wind, the waterfall, and the tide will probably be the only stores of energy on a large scale which will be left at their disposal."[217] Furthermore, the wonders of coal were tempered by Professor Thorpe's discussion of the chemistry of coal. While explaining the chemical reaction of burning coal and its resultant byproducts, he stated, "we have an additional reason why the plague of black smoke which effects so many of our towns should be stayed. The soot not only soils our persons, and clothes, and dirties our buildings and

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[215] Green et. al., *Coal*, 293.

[216] Recently Jean-Francios Mouhot argued a similar point, though one colored with our current climate predicament. Mouhot claimed that fossil fuel use and slave labor serve analogous roles in their respective societies and that the industrial revolution played a vital role in the abolition of slavery. Where many have taken umbrage with his argument is that he also draws the parallel between the negative environmental externalities of current fossil fuel use by carbon-dependent countries as the moral equivalent to slavery.; Jean-Francois Mouhot, "Past Connections and Present Similarities in Slave Ownership and Fossil Fuel Usage," *Climactic Change*, no. 105 (2011): 329-355.; Klas Ronnback, "Slave Ownership and Fossil Fuel Usage: A Commentary," *Climate Change*, no. 122 (2014): 1-9.

[217] Green et. al., *Coal*, 291.

furniture, but its pernicious concomitant, the carbonic oxide, impairs the vitalising action of our air."[218] Thorpe, was so concerned with this that he also included the following coal-based industrial pollution poem:

> Must Britons be condemned for ever to wallow
> In filthy soot, noxious smoke, train oil, and tallow,
> And their poisonous fumes for ever to swallow?
> For with sparky soots, snuffs, and vapours
> men have constant strife;
> Those who are not burned to death are smothered
> during life.

Thorpe's use of the public nuisance of coal smoke in his section concerning the chemistry of coal was illustrative of the fact that the authors of this monograph sought to engage a popular reader viscerally familiar with coal and pervasive issues such as industrial pollution and familiar, if marginally, with natural resource exhaustibility. It was not a purely scientific treatment of coal's properties, but how those properties manifest themselves to the industrial public or what the environmental historian Brett Walker has termed *Homo sapiens industrialis*.[219]

For many, though, God's light shown forth through the "dark abyss" of time and it was fueled by coal. The "succession of worlds" would occur at a pace deemed desirable by *homo industrialis*.[220] At the beginning of the twentieth century, the now famous Svante Arrhenius forecasted climatological impact of burning the earth's stores of fossil

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[218] Green et. al., *Coal*, 196.
[219] Brett L. Walker, *Toxic Archipelago: A History of Industrial Disease in Japan* (Seattle, WA: University of Washington Press, 2010), 6.
[220] The term "dark abyss" is taken from Buffon, and the "succession of worlds" from Hutton.; Rossi, *The Dark Abyss of Time*, ix.

fuels.[221] Far from believing the effect to be negative like the authors above, Arrhenius had considered it a blessing and something that could be directed towards saving humanity from the calamity of another ice age. Calling upon the Carboniferous Period, he explained, "[t]his period is known to us from the extraordinarily large number of plants which we find embedded in the clay of the swamps of those days." But humans have found them after they were "carbonized" and now "their carbon is in our age returned to its original place in the household of nature in the shape of carbonic acid."[222] By burning coal, humans have released this trapped material (carbon dioxide) back into nature. Arrhenius was eternally optimistic about what the future would hold.

> We often hear lamentations that the coal stored up in the earth is wasted by the present generation without any thought of the future, and we are terrified by the awful destruction of life and property which has followed volcanic eruptions of our days. We may find a kind of consolation in the consideration that here, as in every other case, there is good mixed with the evil. By the influence of the increasing percentage of carbonic acid in the atmosphere, we may hope to enjoy ages with more equable and better climates, especially as regards the colder regions of the earth, ages when the earth will bring forth much more abundant crops than at present, for the benefit of rapidly propagating mankind.[223]

Humankind would ultimately benefit from the burning of fossil fuels. Through the agency of industrialized humanity, the earth would become a paradise. Instead of rain following the plow, it would follow the industrial furnace. The process of burning coal is

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[221] James Rodger Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control* (New York: Columbia University Press, 2010), 5.; James Rodger Fleming, *Historical Perspectives on Climate Change* (New York: Oxford University Press, 1998), 65, 74-82.
[222] Svante Arrhenius, *Worlds in the Making: The Evolution of the Universe*. Translated by H. Borns. (New York: Harper & Brothers Publishers, 1908). 58.
[223] Arrhenius, *Worlds in the* Making, 63.

the rewilding of the carbon and energy trapped in the earth. The energy and vibrancy of former environments return to the world. Former climates return and entropy ensues.[224]

Even Lyell who conservatively believed, "if it would be reasonable to draw such inferences with respect to the future, we cannot but apply the same rules of induction to the past," was, as briefly stated above, nonetheless tempted to entertain the possibility that humans would alter the known processes. "It will scarcely be disputed that we have no right to anticipate any modifications in the results of existing causes in time to come, which are not conformable to analogy," Lyell explained, "unless they be produced by the progressive development of human power, or perhaps from some other new relations between the moral and material worlds."[225] Living in an industrial world that had been transformed through the use of powerful fossil fuels, Lyell could not help but to think that humans could, if even only temporarily in terms of geologic time, change the natural order that had lorded over the land for eons.[226]

By at least the 1880s, geologists began to recognize that industrialization had brought something new to the table that would change geologic history.[227] For example, Archibald Geikie titled a section "Man as a Geological Agent" in his 1882 *Text-Book of Geology*.[228] He began this section by stating, "[n]o survey of the geological workings of

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[224] Vaclav Smil, *Energy in Nature and Society: General Energetics of Complex Systems* (Cambridge, MA: The MIT Press, 2008), 6.
[225] Lyell, *Principles of Geology*, Vol. 1, 164.
[226] While enacting temporary changes in their environment, humans nevertheless had to adhere to the laws of nature. Lyell contended, "he would soon perceive that no one of the fixed and constant laws of the animate or inanimate world was subverted by human agency." However, he does seem to allow for the possibility that something could change as a result of an increasing degree of power afforded to humanity.; Lyell, *Principles of Geology*, Vol. 1, 164.
[227] John Robert McNeill, *Something New Under the Sun: An Environmental History of the Twentieth-Century World* (New York: Norton, 2000).
[228] Geikie, *Text-Book of Geology*, 471.

the plant and animal life upon the surface of the globe can be complete which does not take account of the influence of man—an influence of an enormous and increasing consequence in physical geography; for man has introduced, as it were, an element of antagonism to nature."[229] Geikie even predicted that due to the heavy impact of humans on their environment, "in future ages the traces of his interference may introduce an element of difficulty or uncertainty into the study of geological phenomena."[230] Humanity was leaving its mark in the geologic record. If the remains of former life indicated specific ages of stratigraphy, would there need to be a new geologic age created for humanity's mark on the earth?

Some of Geikie's contemporaries thought so. In 1863, James Dwight Dana labeled this period the "Era of Mind. – Age of Man." In this era, "the animal element is no longer dominant, but Mind in the possession of a being at the head of the kingdoms of life."[231] "Man" according to Dana, "was the first being that was not finished on reaching adult growth, but was provided with powers for indefinite expansion." Furthermore, "[h]e was the first being capable of augmenting his strength by bending nature to his service, rendering thereby a weak body stronger than all possible animal force." Humanity was a divine creation destined to dominate all creation according to Dana. "Made in the image of God," Dana stated, "surely he is immeasurably beyond the brute."[232] If humanity was powerful enough to bend nature, would not deep time be superfluous when considering environmental change?

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[229] Geikie, *Text-Book of Geology*, 471.
[230] Geikie, *Text-Book of Geology*, 473.
[231] Dana, *Manual of Geology*, 573.
[232] Dana, *Manual of Geology*, 573-574.

The late nineteenth-century geologist Joseph LeConte also proposed a distinct Era in the geologic time-scale, the "Psychozoic," defined by the existence of the human species and its impact on physical geography and biota.[233] "For the history of the earth," claimed LeConte, "*finds it consummation, and its interpreter, and its significance in man*."[234] The "Psychozoic Era" did not become a standardized Era and geologists debated its use as a proper division of geologic time.[235] However, it is noteworthy that the term did at least remain in scholarly conversation well into the 1930s.[236] Regardless of whether this division of geologic time is adequate for scientific purposes, LeConte was correct in stating that humanity interprets and finds significance in the history of the earth.

Coal inspired a number of nineteenth and twentieth-century scientists to reconsider the powerful position of humanity in relation to the natural environment. It was not the first time that scientists saw humans as wielding a dominating influence over nature.[237] However, this period saw the novel confluence of a scientifically-supported diminution of humanity's presence in the history of the earth, and an acceleration in the species' coal-fueled command of the natural world. There were evident consequences of coal combustion floating through the air, but it was up for debate whether these

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[233] Robert Davis, "Inventing the Present: Historical Roots of the Anthropocene," *Earth Sciences History* 30, no. 1 (2011): 63-84.; Joseph LeConte, *Elements of Geology*, 629-646.; Joseph LeConte, "On Critical Periods in the History of the Earth, and Their Relation to Evolution: On the Quaternary as Such a Period," *The American Naturalist* 11, no. 9 (Sep., 1877): 540-557.; H. S. Williams, "The Making of the Geological Time-Scale," *The Journal of Geology* 1, no. 2 (Feb.-Mar., 1893): 180-197.
[234] LeConte, *Elements of Geology*, 629.
[235] E. W. Berry, "The Term Psychozoic," *Science, New Series* 64, no. 1644 (Jul. 2, 1926): 16.
[236] David Reisman, "Man Before the Dawn of History," *The Scientific Monthly* 37, no. 6 (Dec., 1933): 553-562.
[237] For example, see: Carolyn Merchant, *The Death of Nature: Women, Ecology, and the Scientific Revolution* (New York: Harper & Row, 1989).

externalities could be put to good use. The geological mastery, or at the very least the geological effects of humanity, were real products of coal use and after the Civil War Americans sought to find meaning in the visible effects of their amplified powers.

Conclusion

The work of geology's first deep historians James Hutton and Charles Lyell were informed by cyclical perspectives and the firm conviction that humans played a significant role in the story of the Earth. Coal was central to their project of pushing time's boundaries and provided them with leisure time to perform science by releasing them from the toil typical of pre-industrial societies. The wonders wrought from this black rock also inspired a number of scientists and mining professionals to regard it as a providential product of geologic time. It also played a role in the advancement of American geology as a utilitarian science. Furthermore, coal opened a window into former environments through the fossilized flora that was materially available for scientists and mining professionals to ponder. The fossils found in coal seams would serve to enhance industry's capacity to find and successfully mine coal and they could be signs of danger for miners deep within the earth. This fossilized flora also illustrated Earth's history by demonstrating change and analogical forms that could be compared to contemporary organisms. Geologists saw themselves as historians of the Earth and used their imaginations to travel through time to view the landscape and climactic changes that, for example, were required to form coal. The historical imagination applied to geology allowed for a variety of interpretations to spring from the material remains of the past. A dominant interpretation that arose from the energies of coal-fueled

industrialization was the powers granted to humanity to change the natural world. Out of these developments came the capacity to see alternative landscapes layered over the existing environment, knowledge of Earth's plastic nature, and a faith in the human capacity to change the face of the planet. Coal created the vision and the power to refashion the environment.

As has been demonstrated in this chapter, the geologic histories of western landscapes have captured imaginations since at least the late-eighteenth century. Seeing into the past has affected human relationships with the environment. One problem that has produced this situation is that geologic history is hard to comprehend. John McPhee coined the term "deep time" in 1981 to describe the confounding nature of extreme temporal expanses.[238] The human mind struggles to grasp deep time, and in the process, cultural imperatives seep into our visions of the deep past. Today's environmental challenges make it imperative that we use deep time in our historical scholarship. Contemplating deep time, according to McPhee, can foster "a kind of companionship with the earth."[239] This is why deep history matters. The deep history of an exhaustible resource such as coal should yield respect for the depth of time required for its production, and for the costs of its consumption. Through the use of coal, humans utilize materials generated across vast expanses of geological time. By doing so, humanity has accelerated what have typically been geologic processes, ushering in a human-centered geological epoch recently termed the "Anthropocene."[240] However, as will be discussed

[238] John McPhee, *Basin and Range* (New York: Farrar, Straus, Giroux, 1981), 21.
[239] McPhee, *Basin and Range*, 129.
[240] Will Steffen, Paul J. Crutzen, and John R. McNeill, "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?" *Ambio*, Vol. 36, No. 8 (December, 2007): 614-621.

in the conclusion of the dissertation, this term suffers from its perpetuation of the same mastery narrative that distances humans from the natural world. While fossil fuels, like coal, provided the energy that set social conditions that spurred the scientific insight of deep time, they also made an appreciation of that time depth unlikely.

The deep historical perspective of this study enables us to unite human history to the history of the planet in order to better understand our role in the geophysical transformations, climatological alterations, mass extinctions, and social relationships that define this new epoch. For some during the late nineteenth and early twentieth centuries it humbled how they saw humanity. Voices of caution and concern began to grow as the twentieth century drove forward powered by fossil fuels. For example, Aldo Leopold extolled his audience to consider "Thinking Like a Mountain" because "[o]nly the mountain has lived long enough to listen objectively to the howl of a wolf." He supposed that if we were to learn to think as deeply as a mountain we would not "have dustbowls, and rivers washing the future into the sea."[241] But for many during the nineteenth century, industrialization confirmed humanity's mastery over the natural world and deep time was simply something unworthy of serious attention.[242] New technologies fueled by coal bolstered this belief. Also, as will be demonstrated in the following chapters, the history revealed through the discovery of fossilized flora and fauna in the West captivated Americans and forced them to find ways to understand their significance. The transcontinental railroads were the symbol of technological domination and industrial

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[241] Aldo Leopold, *A Sand County Almanac: With Essays on Conservation from Red River* (New York: Ballantine Books, 1966), 137, 140.

[242] Thomas Burnet's *Sacred Theory* was released around the same time that modern society's narrative of the "Recovery of Eden" emerged with the help of Francis Bacon.; Carolyn Merchant, *Reinventing Eden: The Fate of Nature in Western Culture* (New York: Routledge, 2003), 72-74.

power fueled by coal in the late nineteenth century. It is to this technology we turn in the next chapter.

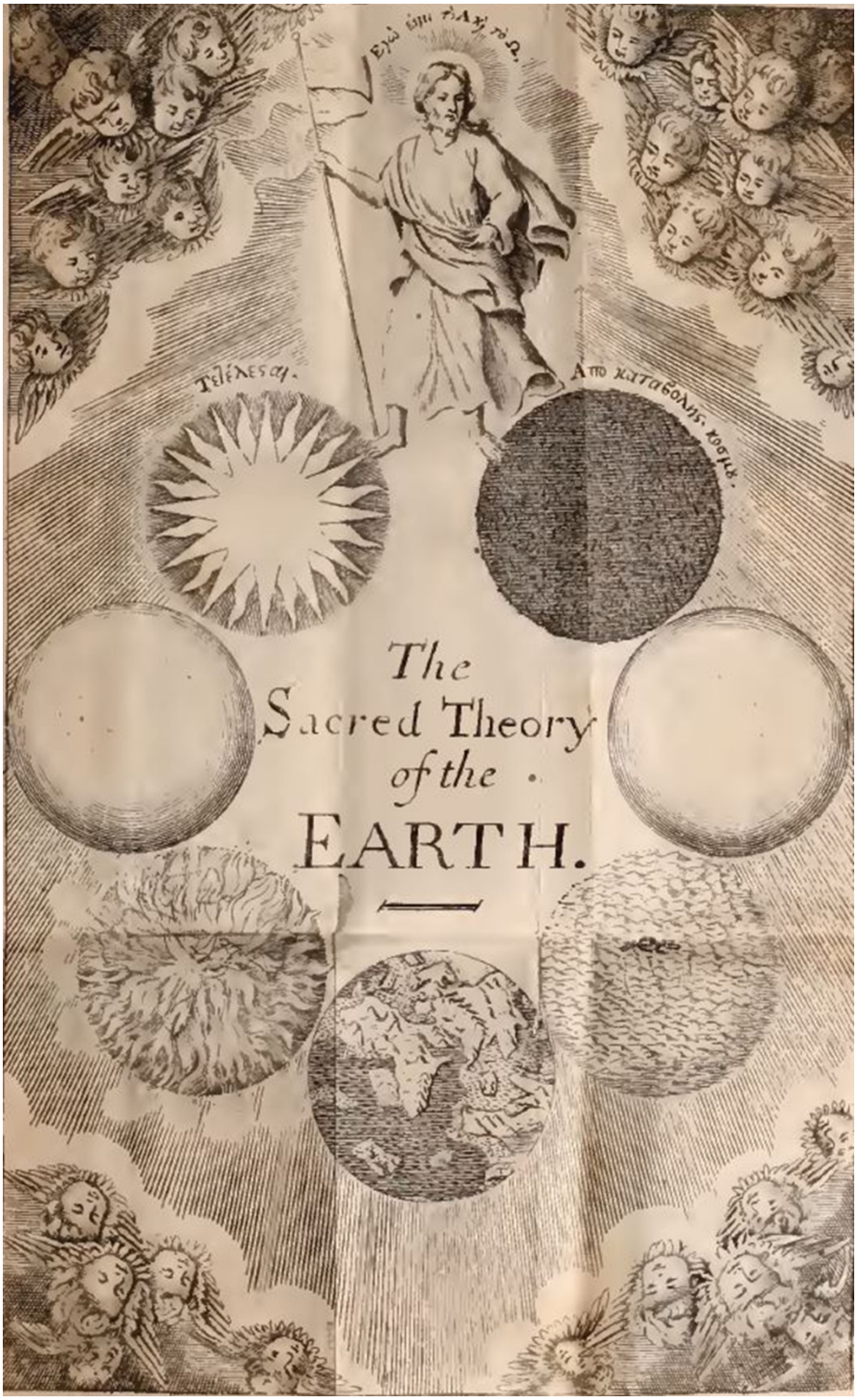


Figure 25. Burnet's Frontispiece. Source: Thomas Burnet, *The Sacred Theory of the Earth*, 2 Vols., Vol. 1 (London: Printed for John Hooke, 1719).

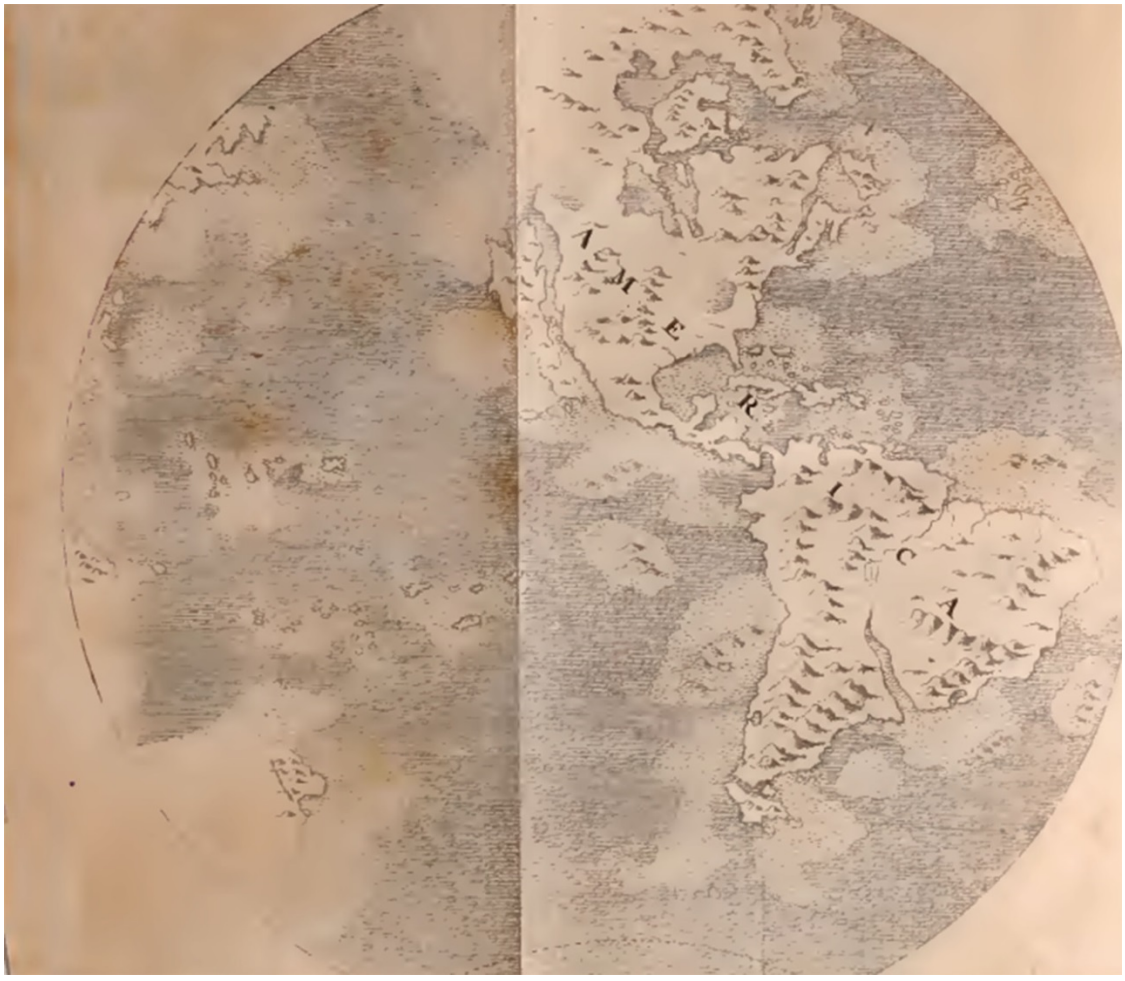


Figure 26. Burnet California Island (1719). Source: Thomas Burnet, *The Sacred Theory of the Earth*, 2 Vols., Vol. 1 (London: Printed for John Hooke, 1719), 206-207.

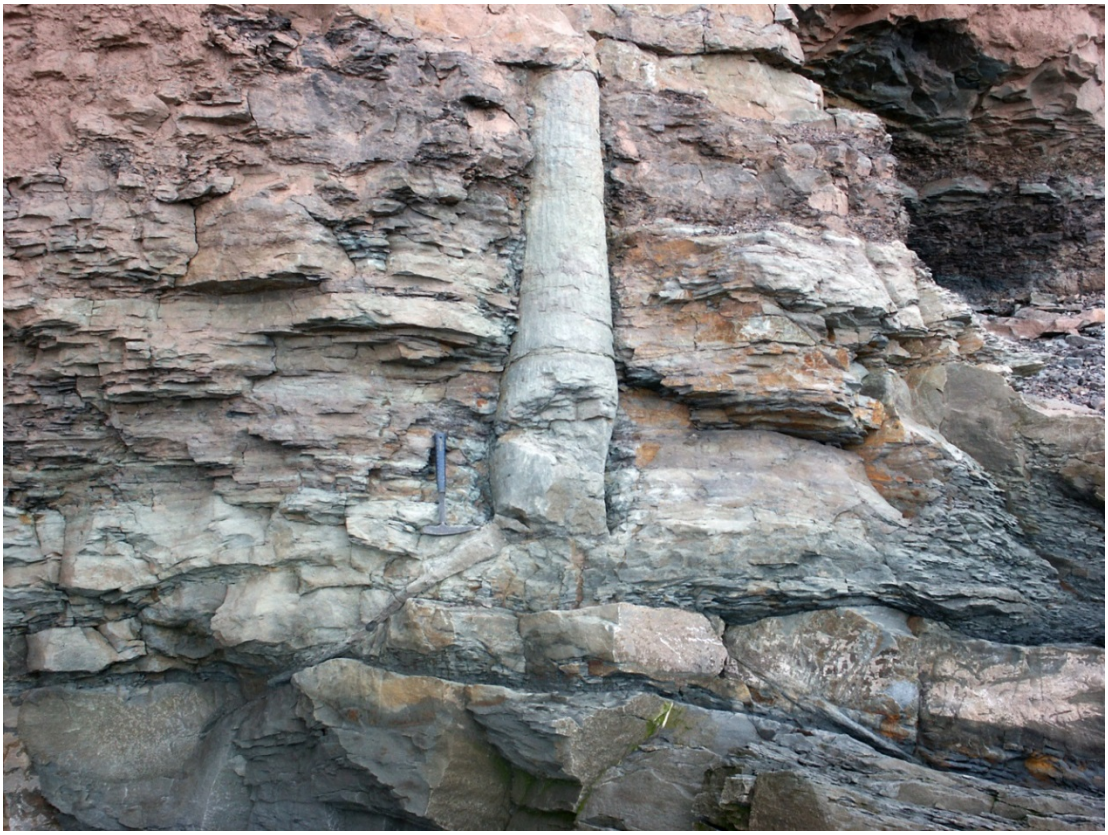


Figure 27. Sigillaria with Stigmaria roots in situ. Source: Michael C. Rygel via Wikimedia Commons. accessed February 20, 2015. http://en.wikipedia.org/wiki/File:Lycopsid_joggins_mcr1.JPG.



Figure 28. Duria Antiquior (1830). Source: Public Domain.

COAL AND THE TRANSCONTINENTAL RAILROADS: TOOLS FOR REIMAGINING AND RECREATING THE ANCIENT WEST

Coal, through its nature and relationship to the transcontinental railroads, was an elemental agent in the settlement of the American West. This energetic resource unites the histories of the transcontinental railroads, western settlement, resource extraction, and American science. Coal's unifying power, however, has often been overlooked or marginalized by historians who have examined these subjects. It is black, and dirty, and is ironically easy to miss due to its ubiquity in industrial America. Coal is not as eye-catching as other glittering historical topics, such as the hard rock mining of precious metals, which have dominated histories of western mining.[1] Overwhelmingly, histories of coal have labor and eastern biases, and the West is typically relegated to small sections in the broader analysis.[2] What has largely been missed is how the arid and treeless nature of western lands, railroad land grants, and settlement in the West created an environment in

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[1] For examples see: William Bryans, "The Mining Frontier of the American West: An Introduction," *OAH Magazine of History* 3, no. 2 (1988).; Andrew C. Isenberg, *Mining California: An Ecological History* (New York: Hill and Wang, 2005).; Susan Lee Johnson, *Roaring Camp: The Social World of the California Gold Rush* (New York: W.W. Norton, 2000).; Timothy J. LeCain, *Mass Destruction: The Men and Giant Mines That Wired America and Scarred the Planet* (New Brunswick, NJ: Rutgers University Press, 2009).; Richard E. Lingenfelter, *The Hardrock Miners: A History of the Mining Labor Movement in the American West, 1863-1893* (Berkeley, CA: University of California Press, 1974).; Mark Wyman, *Hard Rock Epic: Western Miners and the Industrial Revolution, 1860-1910* (Berkeley, CA: University of California Press, 1979).

[2] For examples of the eastern bias in energy and coal histories, see: Alfred W. Crosby, *Children of the Sun: A History of Humanity's Unappeasable Appetite for Energy* (New York: W. W. Norton & Company, 2006).; Barbara Freese, Coal: A Human History (Cambridge, MA: Perseus Publishing, 2003).; Samuel P. Hays, *Conservation and the Gospel of Efficiency: The Progressive Conservation Movement, 1890-1920* (Pittsburgh, PA: University of Pittsburgh Press, 1999).; Martin V. Melosi, *Coping with Abundance: Energy and Environment in Industrial America* (Philadelphia, PA: Temple University Press, 1985).; David E. Nye, *Consuming Power: A Social History of American Energies* (Cambridge MA: The MIT Press, 1998).; Vaclav Smil, *General Energetics: Energy in the Biosphere and Civilization* (New York: John Wiley & Sons, 1991).; Vaclav Smil, *Energy in World History* (Boulder, CO: Westview Press, 1994).; Vaclav Smil, *Energy in Nature and Society: General Energetics of Complex Systems* (Cambridge, MA: The MIT Press, 2008).

which coal mining was essential to the development of the region and where coal fostered visions of a plastic landscape. [3]

This chapter will examine the railroads as a technological system powered by coal. It will trace the concomitant rise of the railroads with America's coal-fueled industrial society in the mid-to-late nineteenth century. Next, the chapter will investigate the exploitation of coal by the Union Pacific Railroad and the Great Northern Railway for the dual purpose of fueling their locomotives and settling sections of the West. Finally, it will cover the rise of the United States Geological Survey of the Territories and the reciprocal relationship between scientists and the railroads in exploring the West for coal and the fossils accompanying it in the earth. It will evaluate the crucial nature of coal for the settling of the American West and the fact that coal's fossil character helped to construct geo-historical visions of the West as a formerly lush and watery region that stood in stark relief to its arid character.

Railroads, Technological Systems, and the Technofaith of Industrializing America

The railroads comprised an envirotechnical system that both reached into deep time to fuel locomotives and changed conceptions of time by condensing space in industrial America.[4] The transcontinentals were powerful forces in colonizing the

[3] For an excellent treatment of the transcontinental railroads and coal mining, and exception for the general tendency for railroad historians to marginalize coal, see: William S. Bryans, "A History of Transcontinental Railroads and Coal Mining on the Northern Plains to 1920" (PhD diss., University of Wyoming, 1987).
[4] For more on envirotechnical analysis, see: Thomas P. Hughes, *Human-Built World: How to Think about Technology and Culture* (Chicago, IL: The University of Chicago Press, 2004), 153-154.; LeCain, *Mass Destruction*, 10, 20, 22, 23.; Sara B. Pritchard, *Confluence: The Nature of Technology and the Remaking of the Rhône* (Cambridge, MA: Harvard University Press, 2011).; David E. Nye ed., *Technologies of Landscape: From Reaping to Recycling* (Amherst, MA: University of Massachusetts Press, 1999).; Martin

western frontier. As a vital industrial energy source during the late nineteenth century process of western expansion, coal fueled the entire system, reinforcing narratives of progress and Manifest Destiny.[5] The railroad was the most powerful artifact of this westward process and linked the hinterlands of the West to the industrial centers of America.[6] The energy released from burning coal in industrial furnaces and the fireboxes of locomotives encouraged Americans to have continued faith in the ability for humans to master any environment. The coal itself illustrated the providential provisions embedded for use by American industry.[7]

More specifically, coal was used to overcome the environmental limitations of a lack of timber in the West so that the transcontinentals could fuel their trek across the continent. Furthermore, those who physically experienced and studied coal came to see the Earth as a product of a sequence or a cycle of geohistorical change. As more and more coal was found and put to use in the West, it was clear that the region had once been far different. The technological faith encouraged by coal and the transcontinental

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Reuss and Stephen H. Cutcliffe, *The Illusory Boundary: Environment and Technology in History* (Charlottesville, VA: University of Virginia Press, 2010).

[5] Manifest Destiny encapsulates a complex set of narratives that served to justify westward expansionism and dispossession. For a sampling of the scholarly treatment of the motivations encapsulated in Manifest Destiny see: Brian W. Dippie, "Drawn to the West," *The Western Historical Quarterly* 35, no. 1 (Spring, 2004): 4-26.; Laurence M. Hauptman, "Westward the Course of Empire: Geography Schoolbooks and Manifest Destiny, 1783-1893," *Historian*, 40 (May 1978); Thomas R. Hietala, *Manifest Design: American Exceptionalism & Empire* (Ithaca, NY: Cornell University Press, 2003).; 423-437.; Julius W. Pratt, "The Origin of 'Manifest Destiny'," *The American Historical Review* 32, No. 4 (Jul., 1927): 795-798.; Anders Stephanson, *Manifest Destiny: American Expansionism and the Empire of Right*, 1st ed., A Critical Issue (New York: Hill and Wang, 1995).; Elliott West, *The Way to the West: Essays on the Central Plains*, Calvin P Horn Lectures in Western History and Culture (Albuquerque, NM: University of New Mexico Press, 1995).; Helen McCann White, "Minnesota, Montana, and Manifest Destiny," *Minnesota* History 38, no. 2 (Jun., 1962): 53-62.

[6] William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: W. W. Norton, 1991).

[7] There was a clear surge in industrial activity after the Civil War. In this context, according to Walter Licht, "[t]he importance of coal in American industrialization cannot be overstated.": Walter Licht, *Industrializing America: The Nineteenth Century*. American Moment. (Baltimore, MD: Johns Hopkins University Press, 1995), 102, 110, 124.

railroads began to convince Americans that the world was malleable. The railroads had also condensed conceptions of space and time for Americans and forced people to see these notions in new ways.[8]

Without sufficient stores of wood and fossil energy that were applied to steam technology, the railroads would not have been as successful in dominating the American continent. There are structures to technological development, but technologies are also artifacts of evolution.[9] Technological development is sustained or constrained depending on their socio-cultural and material environment. Technologies gain "momentum" through these processes and can gain enough power to dominate society.[10] The transcontinental railroads were a technology of this caliber as they wielded a technological system so massive that it entrapped all caught within it. They powered across the nation and held tight on to the reigns of America's destiny.

Americans often understood technologies as granting humanity the power to complete God's creation. James J. Hill, the Great Northern and Northern Pacific Railway magnate discussed later in this chapter, faithfully adhered to this belief.[11] Railroads could work wonders in enhancing the lives of Americans and they were prime examples of the

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[8] Wolfgang Schivelbusch, *The Railway Journey: The Industrialization of Time and Space in the 19th Century* (Berkeley, CA: University of California Press, 1986). 33-44.
[9] Robert L. Heilbroner, "Do Machines Make History?," in *Does Technology Drive History? The Dilemma of Technological Determinism*, ed. Merritt Roe Smith and Leo Marx (Cambridge Massachusetts: The MIT Press, 1994), 55, 65.; George Basalla, *The Evolution of Technology* (New York: Cambridge University Press, 1988).
[10] Thomas P. Hughes, "Technological Momentum," in *Does Technology Drive History? The Dilemma of Technological Determinism*, ed. Merritt Roe Smith and Leo Marx (Cambridge Massachusetts: The MIT Press, 1994), 101, 112.; Thomas P. Hughes, *Networks of Power: Electrification in Western Society, 1880-1930*, (Baltimore, MD: The Johns Hopkins University Press, 1983), 2.; Merritt Roe Smith, "Technological Determinism in America," in *Does Technology Drive History? The Dilemma of Technological Determinism*, ed. Merritt Roe Smith and Leo Marx (Cambridge Massachusetts: The MIT Press, 1994), 34.
[11] David F. Noble, *The Religion of Technology: The Divinity of Man and the Spirit of Invention* (New York: Penguin Books, 1997), 88; David E. Nye, *America as Second Creation: Technology and Narratives of New Beginnings* (Cambridge, MA: The MIT Press, 2003), 283.

technological sublime.[12] While some undoubtedly feared the railroad's impact on their lives and the natural world, many saw that nature's latent potential could be aroused by this powerful technology.[13] Perhaps, the railroad would even end humanity's reliance upon the organic and initiate a new phase of history beyond the limits of nature.[14] Technological progress narratives paired the railroad with the rationalized grid of the public land survey system and spoke of the taming of the western wilderness.[15] The very idea of Manifest Destiny was embodied in the transcontinental railroads.[16]

The story of western settlement demonstrates that technologies and natural resources are impregnated with ideologies and stories that impact their use, direct their cultural production, and justify their uses for power.[17] Railroads commanded the

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[12] David E. Nye, *America as Second Creation*, 157.; David E Nye, *American Technological Sublime* (Cambridge, MA: MIT Press, 1994).

[13] David E. Nye, *America as Second Creation*, 157.; Leo Marx, *The Machine in the Garden: Technology and the Pastoral Ideal in America* (New York: Oxford University Press, 2000).

[14] Leo Marx, "The Impact of the Railroad on the American Imagination, as a Possible Comparison for the Space Impact," in Bruce Mazlish ed., *The Railroad and the Space Program: An Exploration in Historical Analogy* (Cambridge, MA: The MIT Press, 1965), 211-212.

[15] David E. Nye, *America as Second Creation*, 25, 37.; James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press, 1998), 4, 89-90, 331.

[16] Leo Marx stated, "Only a casual knowledge of the period is necessary to recognize that the image of the railroad was widely accepted as an embodiment of the 'spirit of the times' – the Age of Steam; it was taken to represent man's newly acquired power over nature, and the idea of history as a record of virtual inevitable improvement or, in a word, progress."; Leo Marx, "The Impact of the Railroad…", 208.

[17] For how technologies were used as a measure of civilization, see: Michael Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca, NY: Cornell University Press, 1989), 221, 267.; Michael Adas, *Dominance by Design: Technological Imperatives and America's Civilizing Mission* (Cambridge, MA: Belknap Press of Harvard University Press, 2006). 79-80, 90.; For how coal was used to measure levels of civilized life, see the 1872 publication *The Duty on Coal*, by Israel Wistar Morris. He argued that, "[t]he production and consumption of fuel in any country may be taken as a fair measure of its manufacturing prosperity, and even of its civilization; for it is well known that as mankind advance in knowledge, their increased wants demand the increased use of heat. The lowest grade of savages eat their meat raw, and use few if any clothes."; Israel Wistar Morris, *The Duty on Coal: Being a Few Facts Connected with the Coal Question, which will Furnish Matter for Thought to the Friends of American Industry* (Philadelphia, PA: Henry Carey Baird, Industrial Publisher, 1872), 3.; However, it is well-established that while coal was not used on an industrial level, Native Americans did indeed use coal. For example see: Ronald L. Bishop, Veletta Canouts, Suzanne P. De Atley, Alfred Qoyawayma, C. W. Aikins, "The Formation of Ceramic Analytic Groups, Hopi Pottery Production and

American western landscape at the key moment of intersection in which technological progress narratives were triumphant, industrial capitalism was at a productive apex, and the United States had "virgin" continental lands to colonize and exploit.[18] They exemplified America's rapid industrialization. Along with the inception of the modern use of the term technology, the philosophy of progress-based technological determinism took root during the blossoming of American industrial capitalism.[19] After the Civil War, coal-fueled railroads brought industrialization to the West and were potent symbols of the nation's destiny and the human capacity to dominate creation.[20]

Exchange, A. C. 1300-1600," *Journal of Field Archeology* 15, no. 3 (Autumn, 1988): 317-337.; Dudley A. Gardner and Verla A. Flores, *Forgotten Frontier: A History of Wyoming Coal Mining* (Boulder, CO: Westview Press, 1989), 3.; Priscilla Long, *Where the Sun Never Shines: A History of America's Bloody Coal Industry* (New York: Paragon House, 1989), 8, 174.; David A. Wolff, *Industrializing the Rockies: Growth, Competition, and Turmoil in the Coalfields of Colorado and Wyoming, 1868-1914* (Boulder, CO: The University Press of Colorado, 2003), 2.; Presently, Native Americans control a large portion of the coal reserves in the United States. For example see; David Rich Lewis, "Still Native: The Significance of Native American History in the History of the Twentieth-Century American West," *The Western Historical Quarterly* 24, no. 2 (May, 1993): 203-227.

[18] It must be recognized, however, that some historians see the work of the railroads and industrialization after the Civil War as a continuation of the economic activity already underway in the antebellum period. They essentially provided a wider arena for economic opportunity by reducing transportation costs and making possible the exploitation of previously uneconomical western natural resources.: Robert William Fogel, "Railroads as an Analogy to the Space Effort: Some Economic Aspects," in Mazlish ed., *The Railroad and the Space Program: An Exploration in Historical Analogy*, 104.; Walter Licht, *Industrializing America: The Nineteenth Century* (Baltimore, MD: Johns Hopkins University Press, 1995), 126-127,131.; However, the railroads were a powerful force in the future of the American economy. According to Alfred D. Chandler, the railroads were also pioneers in modern management and business administration.; Alfred D Chandler, *The Visible Hand: The Managerial Revolution in American Business* (Cambridge, MA: Belknap Press, 1977).; Alfred D. Chandler, *The Railroads, Pioneers in Modern Management* (New York: Arno Press, 1979).; Alfred D. Chandler, *The Railroads, the Nation's First Big Business: Sources and Readings*. Forces in American Economic Growth Series (New York: Harcourt, 1965).; Alfred D. Chandler Jr. and Stephen Salisbury, "The Railroads: Innovators in Modern Business Administration," in Bruce Mazlish ed., *The Railroad and the Space Program: An Exploration in Historical Analogy*, 128.; See also: Thomas C. Cochran, *Frontiers of Change: Early Industrialism in America* (New York: Oxford University Press, 1981), 124-6.

[19] Leo Marx, "Technology: The Emergence of a Hazardous Concept," *Technology and Culture* 51, no. 3, (July, 2010), 575.

[20] Thomas P. Hughes stated, "As a result of the experience, Western man's Promethean confidence that he could recreate and order the world was heightened; his educational system felt the impact through curriculum changes and the demand for rational, teachable information in a broad new field; the security-engendering idea of co-ordinating disparate elements into a predictable action system was reinforced; and his mastery of new techniques utilized. All of these results were discernable in the nineteenth century.":

Fueling the Nation's Westward Progress in the Early Nineteenth Century

Thomas Jefferson dreamed of a republic dotted with small farms, but he could not ignore the incredible power of industrial might borne from coal. His colleague Alexander Hamilton believed that America's future, like Britain's, would be industrial.[21] This future would inevitably depend upon vast reserves of potential energy entombed in the earth. The question arose whether the Louisiana Territory would add to the already impressive resources of Pennsylvania and West Virginia. Tasked with inventorying natural resources useful for the development of the new nation, Lewis and Clark indicated where they found fossil fuels for America's industrial future.[22] The fossilized nature of the coal that they found also illustrated the malleable nature of the West. The reports of coal sent back by Lewis and Clark represent some of the earliest surveys of the region's available coal resources. While they lived in a world of water transport, their explorations set the stage for the future exploitation of these energetic resources by the transcontinental railroads.

Thomas Park Hughes, "A Technological Frontier: The Railway," in Mazlish ed., *The Railroad and the Space Program: An Exploration in Historical Analogy*, 71.; Carroll Pursell, *The Machine in America: A Social History of Technology* (Baltimore, MD: Johns Hopkins University Press, 1995), 177.; For histories that speak of the industrial West, see: David Igler, *Industrial Cowboys: Miller & Lux and the Transformation of the Far West, 1850-1920* (Berkeley, CA: University of California Press, 2001).; David A. Wolff, *Industrializing the Rockies: Growth, Competition, and Turmoil in the Coalfields of Colorado and Wyoming, 1868-1914* (Boulder, CO: University Press of Colorado, 2003).

[21] Jacob E. Cooke, "Tench Coxe, Alexander Hamilton, and the Encouragement of American Manufactures," *The William and Mary Quarterly* 32, no. 3 (1975).; Leo Marx, *The Machine in the Garden*, 167-169.

[22] For information on the geology and paleontology of the Lewis and Clark Expedition, see: R. F. Diffendal Jr. and Anne P. Diffendal, "Lewis and Clark and the Geology of the Great Plains" edited by Conservation and Survey Division/School of Natural Resources/Institute of Agriculture and Natural Resources/College of Arts and Sciences (Lincoln, NE: University of Nebraska, 2003).; John W. Hoganson and Edward C. Murphy, *Geology of the Lewis & Clark Trail in North Dakota* (Missoula, MT.: Mountain Press Pub., 2003).; John W. Jengo, '"Mineral Productions of Every Kind': Geological Observations in the Lewis and Clark Journals and the Role of Thomas Jefferson and the American Philosophical Society in the Geologic Mentoring of Meriwether Lewis," in Robert S. Cox et al., "The Shortest and Most Convenient Route: Lewis and Clark in Context," *Transactions of the American Philosophical Society* 94, no. 5 (2004): 136-214.

By the late nineteenth century, the seemingly contradictory visions of Hamilton and Jefferson were combined as the large expanses of the West proved valuable to American industrialization and the railroads encouraged western agriculture.[23] Westerners would be wrapped up in this process as the coal beneath their feet became central to American life. Through the journals of Lewis and Clark and the lives of western settlers this section demonstrates that, since the early nineteenth century, pioneering Americans were aware that the frontier contained valuable fossilized energy that would allow them to survive in the absence of trees.

The story of coal use in the North American West began quite early. In North Dakota, there are indications that lignite coal had been used in the region for four thousand years and in the southwest the Hopis had burned coal for at least seven hundred years to make clay pots.[24] Euro-American knowledge of western coal came from early explorations by military and government surveyors, explorers, fur trappers, and Native Americans who yielded some of the earliest reports of coal in western territories during the early and mid-1800s.[25] A good example of these early coal finds and indications of coal use by settlers in the West comes from the Lewis and Clark Expedition discussed previously in Chapter 1. At the start of their journey along the Illinois-Missouri border,

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[23] According to Leo Marx, there were three symbols of the railroad that operated in the nineteenth century, "*The triumphant machine*," "*The ambiguous machine*", and "*The menacing machine*." Like many elements of history, there was no single vision that operated at any one moment in time. The "*triumphant machine*" was the most popular, but the other two symbols illustrated that there was a considerable amount of unease associated with the rapid pace of industrialization in America. The national goals of agrarianism and industrialism would seem to be at odds, but were held in tension in many American's minds.; Leo Marx, "The Impact of the Railroad on the American Imagination, as a Possible Comparison for the Space Impact," in Mazlish ed., *The Railroad and the Space Program: An Exploration in Historical Analogy*, 207, 210-215.

[24] Bryans "A History of Transcontinental Railroads…", 32-33.; Freese, *Coal*, 112.

[25] Dudley and Flores, *Forgotten Frontier*, 6.; Wolff, *Industrializing the Rockies*, 4.; Bryans, "A History of Transcontinental Railroads…", 27-63.

Lewis remarked on the "many fine mines of pitt Coal on this stream, and one not far from its mouth whence boats asscend in common and high tide are loaded with and transport it the Saline on W. of mississippi and to Kaskaskias & elsewhere for the use of the blacksmiths and other artizans."[26] A short distance up the Missouri, near where the Expedition encamped for the winter of 1803-04, they passed a "Coal hill" that "Contain[ed] great quantytes of Coal" mined locally and situated near a French community in a "butifull" region with "a number of American Settlers."[27] Outside of Kansas City in late June of 1804, the party was delayed by "a thick fog," but once it lifted Clark saw a coal mine and that the bank of the river contained "great quantity of fine Coal…of the best quality."[28] In this frontier zone, coal (of the Carbondale Formation of Pennsylvanian Age) was already being mined and transported for local use as an important source of energy for settlers and pre-industrial craftsmen – blacksmiths and artisans.

As they proceeded on their course Lewis and Clark discovered that the north-central Louisiana Territory contained a considerable amount of fossil energy. In late August of 1804, when the party entered the southeast corner of South Dakota, regular references to coal began to appear in their journal entries. Many of the references simply

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[26] Meriwether Lewis, William Clark, et al., November 25, 1803 entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1803-11-25.xml&_xslsrc=LCstyles.xsl.

[27] Meriwether Lewis, William Clark, et al., May 16, 1804 entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1804-05-16.xml&_xslsrc=LCstyles.xsl.

[28] Meriwether Lewis, William Clark, et al., June 25, 1804 entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1804-06-25.xml&_xslsrc=LCstyles.xsl.

record the presence of coal in the river bluffs that they could easily view as they proceeded along their river courses. From Fort Mandan, Lewis's report indicated the abundance of what he called "carbonated wood." This was likely lignite coal and was labeled "wood" because of the impurities in the form of fossilized flora. This woody coal was found along the Missouri "in considerable quantaties in many places."[29] Later Lewis hypothesized that the "carbonated wood" that he had found was in fact "petrefyed" by the "water of the river."[30] The impure coal located by Lewis made him curious about how it was formed and where it came from. It showed signs that there were trees to make such material, but it must have struck him that the land around him was not well timbered.

Well before the building of the transcontinental railroads, the coal of the Northern Plains supported emigrants, the military, miners, and early settlers along the early trails westward.[31] The Expedition had found that the regions beyond the Platte River showed themselves to be fertile yet sparsely wooded.[32] Wood fuel would be hard to find for settlers seeking to populate the fertile lands of the north-central West. The abundant coal resources located by Lewis and Clark could serve to support agricultural settlement in

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[29] Meriwether Lewis, William Clark, et al., "Fort Mandan Miscellany, Part 4: Mineralogical Collections" entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1804-1805.winter.part4.xml&_xslsrc=LCstyles.xsl.

[30] It was in fact not the river that "petrefyed" the wood he had found. Unknown to him, the "stones" of petrified wood were formed in the Paleocene and were a part of the Sentinel Butte Formation.: Meriwether Lewis, William Clark, et al., April 16, 1805 entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1805-04-16.xml&_xslsrc=LCstyles.xsl#noten11041602.

[31] Bryans, "A History of Transcontinental Railroads…", 48-56.

[32] Meriwether Lewis, William Clark, et al., "Postexpeditionary Miscellany, Part 2: Miscellany" entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1806.postexpedition.part2.xml&_xslsrc=LCstyles.xsl.

this frontier region just as it was powering the furnaces of settlements downriver.[33] By the mid-nineteenth century, the coal finds of Lewis and Clark were of greater importance and worked to supplement eastern sources as coal helped set the stage for the industrialization of America.[34] Domestic uses were also rising as coal rapidly became the primary means of heating homes and cooking meals.[35] By the late nineteenth century, there would even be disparities between the wealthy and the poor regarding the quality of coal one could obtain for domestic use.[36] In Wyoming and North Dakota "wagon mines" were used to transport coal from exposed seams to provide a means to heat and cook in remote homesteads.[37] Some of these mines were quickly abandoned, but others paved the way for future development and speculation.[38] Towns sprouted around western coal deposits.[39] Coal was fast becoming the fuel source of the future, and by necessity many westerners were intimately familiar with its powerful uses. More and more lives were

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[33] Lewis and Clark's experience with "carbonated wood," coal, fertile lands, and little timber can be seen in the following journal entries as they made their way through the north central West.; Meriwether Lewis, William Clark, et al., April 9, 10, 11, 29, 28 and May 8, 1805 entries in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005) http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1805-04-09.xml&_xslsrc=LCstyles.xsl.; http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1805-04-10.xml&_xslsrc=LCstyles.xsl.; http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1805-04-11.xml&_xslsrc=LCstyles.xsl.; http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1805-04-29.xml&_xslsrc=LCstyles.xsl.; http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1805-04-28.xml&_xslsrc=LCstyles.xsl.; http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1805-05-08.xml&_xslsrc=LCstyles.xsl.

[34] Freese, *Coal*, 125.

[35] Freese, *Coal*, 142.; Nye, *Consuming Power*, 109.

[36] Andrews, *Killing for Coal*, 68.

[37] Gardner and Flores, *Forgotten Frontier*, 63-64.; Ed Murphy, "Mineral Resources of North Dakota: Coal," North Dakota Geological Survey, accessed February 3, 2015, https://www.dmr.nd.gov/ndgs/mineral/nd_coalnew.asp.

[38] Gardner and Flores, *Forgotten Frontier*, 64.; Bryans, "A History of Transcontinental Railroads…" 56.

[39] Glen Barrett, *Kemmerer, Wyoming: The Founding of an Independent Coal Town, 1897-1902* (Kemmerer: Quealy Services, 1975).; Alvar W. Carlson, "Lignite Coal as an Enabling Factor in the Settlement of Western North Dakota," *Great Plains Journal* 11, (Spring 1972): 145-153.; Bonnie Christensen, *Red Lodge and the Mythic West: Coal Miners to Cowboys* (Lawrence, KS: University Press of Kansas, 2002).; R.M. Giannini, *A History of Sand Coulee, Montana: An Early Coal Mining Town in Cascade County* (Self Published: 1985).; Bill Whithorn and Doris Whithorn, *A Photo History of Aldridge, Coal Camp That Died a-Bornin'* (Minneapolis, MN: Printed by Acme Printing and Stationery, 1965).

entwined with coal and their intimacy with this resource would have revealed its fossil character.[40] At the same time, it allowed them to transcend the natural limits of the West and conquer the wilderness.[41]

Powering the Industrial Railroads

The expeditions that followed Lewis and Clark began to fill in the cartographic gaps left by their limited traverse across the continent. Some of these men were fur trappers in search of beaver pelts.[42] As a consequence of their ambitions for wealth they acquired environmental knowledge that was used by official government scientists and surveyors. In the middle of the nineteenth century, settlers and those seeking gold and silver riches dismissed reports of a Great American Desert and persisted into the formidable western environment along well-worn paths such as the Oregon Trail.[43] The transportation networks and environmental information that developed from this tide of settlement aided in reviving the dream of a transcontinental American empire. If an easy river passage could not be found, the technology of the railroad would create a path across the continent and revive dreams of a fertile continent with untold natural resources. This section examines the energy transition from wood to coal after the Civil

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[40] This is especially the case in lignite formations where this type of low-quality coal would have, just as it did to Lewis and Clark, revealed its former vegetative qualities.

[41] For a discussion of how coal was wrapped up in democracy and structures of political power, see: Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (New York: Verso, 2011).

[42] Hiram Martin Chittenden, *The American Fur Trade of the Far West: A History of the Pioneer Trading Posts and Early Fur Companies of the Missouri Valley and the Rocky Mountains and the Overland Commerce with Santa Fe*. 3 Vols. (New York: Francis P. Harper, 1902).; William H. Goetzmann, *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West* (New York: Knopf, 1966), 105-198; Marc Reisner, *Cadillac Desert: The American West and Its Disappearing Water* (New York: Penguin Books, 1993), 19-24.

[43] Though during this period, the middle of the continent was largely overlooked for what lay beyond it in the mountains.; John L. Allen, "The Garden-Desert Continuum: Competing Views of the Great Plains in the Nineteenth Century," *Great Plains Quarterly* 5, no. 4 (1985): 213.

War and the synergistic role that the western railroads played in making this shift in the West.

The Pacific Railroad Surveys, led by the War Department, continued the Humboldtian and Baconian traditions of holistic data gathering.[44] The stated goal of the 1853 Pacific Railroad Survey Act was to find a "practical and economical route for a railroad from the Mississippi to the Pacific Ocean." Four routes were chosen and each expedition's scientific work was overseen by the Smithsonian Institution, which supplied the scientific instruments and issued the collection directives. [45] Specimens were sent back to Washington, D.C. and the results were written up in a fourteen volume set that was at once ethnographic and detailed the geology, geography, topography, climate, botany, and zoology.[46] Congressionally funded and constrained within a ten month time-frame, the survey parties acquired a semi-superficial but synthetic view of the proposed routes.[47]

Coal was fast becoming the industrial fuel of choice in America and references to its presence, absence, quality, and quantity featured prominently in the geological reports contained within each of the railroad survey volumes. Like the geologists discussed in Chapter 2, the survey geologists used fossilized flora to indicate the geologic age of the

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[44] William H. Goetzmann, *Army Exploration in the American West 1803-1863* (New Haven, CT: Yale University Press, 1959), 336.; For more information on the Pacific Railroad Survey, see: Richard V. Francaviglia and Jimmy L. Bryan Jr, "'Are We Chimerical in This Opinion?' Visions of a Pacific Railroad and Westward Expansion before 1845," *Pacific Historical Review* 71, no. 2 (2002): 179-202.; Goetzmann, *Exploration and Empire*, 265-302.

[45] Robert V. Hine and John Mack Faragher, *The American West: A New Interpretive History* (New Haven, CT: Yale University Press, 2000), 280-1.

[46] United States War Department, "Table of Contents for Reports of Explorations and Survey to Ascertain the Most Practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean." *Reports of Explorations and Surveys, to Ascertain the Most Practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean* Vol. 1 (Washington: Beverley Tucker, Printer, 1855), iii-vii. http://name.umdl.umich.edu/AFK4383.0001.001.

[47] Goetzmann, *Exploration and Empire*, 281.

coal.[48] They also noted the importance of the extensive fields of coal found in the West. For example, the Governor of Washington Territory, Isaac Stevens compiled the twelfth volume of the survey reports. After referencing the value of timber, he noted that "[t]he lignite of this region, traced from the coulees of Mouse river to the headwaters of Milk, a distance of five hundred miles, apparently underlies this whole district, in a bed varying from a few inches to six feet thick, and is a source of fuel not to be overlooked."[49] Timber was not only essential for the railroads as a fuel; it was used to construct tracks, cars, and structures along the lines. Timber's use as a raw material ensured that the railroads continued to exploit this resource at high levels even after the transition to coal. In fact, the exploitation of timber in areas with minimal forest reserves had the effect of pushing railroads to more closely consider coal as an alternative fuel.[50] Also, the use of forest products in coal mines increased as demand for fossil fuels increased.[51] Contrary to what many contemporaries believed about the power of the railroads, they increased humanity's reliance on natural resources and cycles rather than lifting humans above and beyond natural rhythms and limits.[52]

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[48] The survey geologist noted, "Dr. G.G. Schumard is very positive in his opinion that this coal is of the true Carboniferous period, and says that it is characterized by the fossil ferns of that era.": William P. Blake, *Report of the Geology of the Route, near the Thirty-Second Parallel: Prepared from the Collection and Notes of Capt. Pope* (Washington, D.C. 1856), 31.

[49] Isaac Stevens, *Reports of Explorations and Surveys, to Ascertain the Most Practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean* Vol. XII (Washington: Thomas H. Ford, Printer, 1860), 334-335.; For more information, see: "Isaac I. Stevens and the Pacific Railroad Survey of 1853," *Minnesota History* 7, no. 2 (1926): 127-149.

[50] Paul H. Cootner, "The Economic Impact of the Railroad Innovation," in Mazlish ed., *The Railroad and the Space Program: An Exploration in Historical Analogy*, 119.

[51] Andrews, *Killing for Coal*, 138.

[52] A similar process occurred with industrialization and horses. See: Ann Norton Greene, *Horses at Work: Harnessing Power in Industrial America* (Cambridge, MA: Harvard University Press, 2008).; It is also crucial to keep in mind that the transcontinental railroads had a significant environmental impact on the West. However, Richard Orsi has recently claimed that they were good environmental stewards and were on the front lines of ecological management through "Enlightened self-interest.": Richard J. Orsi, *Sunset*

Initially in the West, the steamboat dominated mechanical transportation. But it was limited geographically to navigable rivers. By the end of the Civil War, railroads began to replace the steamboat and open up new regions to settlement and commerce. At first, the steamboat and the railroad were both reliant on wood as a fuel.[53] Yet, soon after the War, coal had come to surpass wood as a fuel source everywhere except for heavily forested regions on the coasts.[54] Coal development in America was a gradual process, in part because of the many well-wooded regions capable of being exploited.[55] The Civil War was a turning point for the use of coal since the demands of war required this additional fuel.[56] After the Civil War, many regions in the West were using coal in their blast furnaces for manufacturing iron.[57] This pairing of coal and iron made the industrial revolution possible by unleashing the power of steel for the construction of industrial artifacts like steel rails.[58] Coal was a very useful fuel, but it did not make railroads the dominant mode of travel in America. Instead the railroads helped to make coal a ubiquitous industrial and domestic fuel.[59] Canals had previously played this role, but relying on these waterways limited the range of coal's use.[60] The eastern railroads in

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Limited: The Southern Pacific Railroad and the Development of the American West, 1850-1930 (Berkeley, CA: The University of California Press, 2005), 60.

[53] Melosi, *Coping with Abundance*, 21.

[54] Melosi, *Coping with Abundance*, 22.

[55] Cochran, *Frontiers of Change*, 51, 70-71.

[56] Albro Martin, *Railroads Triumphant: The Growth, Rejection, and Rebirth of a Vital American Force.* (New York: Oxford University Press, 1992), 143-144.

[57] Melosi, *Coping with Abundance*, 29.

[58] Cochran, *Frontiers of Change*, 92-93; Thomas J. Misa, *A Nation of Steel: The Making of Modern America, 1865-1925* (Baltimore, MD: Johns Hopkins University Press, 1995).; Sherry H. Olson, *The Depletion Myth: A History of Railroad Use of Timber* (Cambridge, MA: Harvard University Press, 1971), 45.

[59] Melosi, *Coping with Abundance*, 27.; Albro Martin, *Railroads Triumphant*, 134, 135

[60] Christopher F. Jones, "A Landscape of Energy Abundance: Anthracite Coal Canals and the Roots of American Fossil Fuel Dependence, 1820–1860," *Environmental History* 15, no. 3 (2010): 449-484.; Cochran, *Frontiers of Change*, 79-80.

major coal mining districts began facilitating transportation for coal to be used for industrial purposes. It was this growing use by industry fostered by the railroads that made coal *the* energy source of industrial America by 1885.[61] The railroads obviously benefitted from this relationship in the revenue generated from hauling this fossil fuel, and soon coal was the principal source of fuel for locomotives.[62] The mines themselves were also often large consumers of coal. [63] Wood had helped industrialize America, but coal brought America into the modern age and would power the future.[64] Coal altered settlement and the environment, and consumers now counted on the cheap transportation of goods, while competitive energy markets shielded them from labor and environmental disruptions.[65] As soon as Americans began to extract power from coal at scale in the late nineteenth century, every citizen of the nation became at least distantly tied to this ancient ecology. The North American continent's geologic history subsidized all of industrial society.[66]

Many of the coal seams of the West were entrapped by the earth until the arrival of the railroads.[67] Coal was not a viable industrial resource until railroads such as the Union Pacific established a method for transport to market and quickly maintained a monopoly over coal resources along their lines.[68] Using their lines to bind together

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[61] Melosi, *Coping with Abundance*, 28.; Cootner, "The Economic Impact of the Railroad Innovation," 118-119.; Smil, *Energy in Nature and Society*, 264.
[62] Melosi, *Coping with Abundance*, 30.; In fact, bituminous coal, which is abundant in the West, was preferred in the transition since it had a lower heat at which it burned and would not destroy the early steam boilers.; Cochran, *Frontiers of Change*, 110.
[63] Andrews, *Killing for Coal*, 61, 75.
[64] Melosi, *Coping with Abundance*, 34.; Andrews, *Killing for Coal*, 84.
[65] Andrews, *Killing for Coal*, 60.
[66] Nye, *Consuming Power*, 103.; Andrews, *Killing for Coal*, 53-55.
[67] Bryans, "A History of Transcontinental Railroads…", 27, 56.; Andrews, *Killing for Coal*, 52.
[68] Gardner and Flores, *Forgotten Frontier*, 6-9, 26.

distant locales, the Union Pacific, the Northern Pacific Railroad, and the Great Northern Railroad forged the West's commercial coal mining industry.[69] Towns throughout the West followed the railroad and the creation of coalmines.[70] Fuel was one of the largest expenses for railroads and as a result the owners, engineers, and geologists of the transcontinental railroads were attuned to the energy transition to coal and used deposits to determine where to lay track and where to boost for settlement.[71] Coal, therefore, played a significant role in the growth and development of the land traversed by the transcontinentals.[72]

A significant factor in the critical nature of western coal was the lack of forests to exploit.[73] In burgeoning cities like Denver, coal was a vital energy resource because wood fuel was scarce.[74] The Union Pacific, Great Northern, and Northern Pacific Railroads will be discussed later, but here it is worth briefly commenting on some of their successes in securing coal resources. In the case of Wyoming, the first coal town was Carbon, founded in 1868 upon coal resources located on the Union Pacific Railroad government land grants.[75] The Union Pacific utilized the vast stores of coal in places like

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[69] Bryans, "A History of Transcontinental Railroads…", preface.; Cootner, "The Economic Impact of the Railroad Innovation," 123.
[70] William Wyckoff, *Creating Colorado: The Making of a Western American Landscape 1860-1940* (New Haven, CT: Yale University Press, 1999), 206-207, 211.
[71] Bryans, "A History of Transcontinental Railroads…", abstract, 223.; Andrews, *Killing for Coal*, 52-54.
[72] Bryans, "A History of Transcontinental Railroads…", 234.; Nye, *Consuming Power*, 109.
[73] Andrews indicates the absence of adequate fuel wood and timber for the erection of viable settlements in Colorado.; Andrews, *Killing for Coal*, 38, 41, 74-75.
[74] Long, *Where the Sun Never Shines*, 176.
[75] Gardner and Flores, *Forgotten Frontier*, 15.; Wolff, *Industrializing the Rockies*, x-xi.; For histories of the Union Pacific Railroad, see: Emmett D. Chisum, "Boom Towns on the Union Pacific: Laramie, Benton and Bear River City," *Annals of Wyoming: The Wyoming History Journal* 53, no. 1 (1981).; John Patterson Davis, *The Union Pacific Railway: A Study in Railway Politics, History, and Economics* (Ayer Co Pub, 1894).; Maury Klein, *Union Pacific*, 2 vols. (Garden City, NY: Doubleday, 1987).; George Pryde, "The Union Pacific Coal Company 1868 to August 1952," *Annals of Wyoming: The Wyoming History Journal* 25 (July, 1953): 190-205.

southern Wyoming and was able to sustain long-run coal mining ventures. Eventually southwestern Wyoming and the Front Range of Colorado developed into the West's premier coal-producing region.[76] The Great Northern and Northern Pacific did not have as many long-term successes in commercial coal as they rode across the northern section of the West. However, they were able to overcome the trials of the treeless plains by temporarily tapping into the coal along their lines.[77]

Coal brought the transcontinental railroads profit and power to sail across the plains. The author of an 1872 government report on mining in the West put it this way:

> The art of mining may be said to have given birth to the railway system. Not only was the steam-engine primarily employed in mining and developed in obedience to the necessities of that industry, but long before the use of steam as a motor the idea of traction upon tramways was originated, so far as we can now discover, in mines…Railways…have continually tended toward forms of construction involving greater cost and requiring greater income for their profitable maintenance, and have thus been almost excluded from the immediate neighborhood of many mining districts. The coal and iron mines, the products of which are bulky and give rise directly and indirectly to a vast transportation business, form exceptions to this rule.[78]

The history of western coal and the transcontinentals was one of symbiosis. Coal mining yielded the steam engine which drove the transcontinentals which then continued to require access to more mines. Crossing the treeless plains of the West and its high mountains was no simple task; it required stores of energy. Luckily the Rocky Mountains

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[76] Wolff, *Industrializing the Rockies*, 2, 56.; Long, *Where the Sun Never Shines*, 170, 173-4, 179.; Bryans, "A History of Transcontinental Railroads…", 66.
[77] Bryans, "A History of Transcontinental Railroads…", preface.
[78] Raymond W. Rossiter, *Statistics of Mines and Mining in the States and Territories West of the Rocky Mountains* (Washington: Government Printing Office, 1872), 483.

and the surrounding plains contain a considerable amount of Cretaceous coal. In 1902, Lucius S. Storrs described the region as follows:

> The coal fields of the Rocky Mountain region occupy a belt along the eastern base of the main range, extending southward from the Canadian boundary fully 1,000 miles, through Montana, Wyoming, Colorado, and New Mexico…in which the coal is generally bituminous. In addition to these fields…the coal-bearing formations extend eastward from the mountains and underlie large areas of the plains in Montana, Wyoming, and the Dakotas. In these fields the coal is generally a lignite, and therefore at present chiefly important as a source of fuel for local use.[79]

The higher quality bituminous coal could be used to fuel the locomotives across the Rockies and the lower quality lignite could be used by the settlers populating the towns along the line. Lignite's fossilized impurities that indicated the vegetable nature of coal would have shown settlers material evidence of a former world. At the same time, the bituminous coal powering the railroads would have convinced them of the role of technology in mastering nature.

The year 1900 is often cited as the date when the U.S. surpassed Britain in coal production and consumption.[80] This process could not have been secured without western sources of coal. The railroads paid close attention to coal production as it accelerated. For example, in 1907 an internal letter to the president of the Great Northern Railway from a mining geologist noted that the states of Colorado, North Dakota, Montana and Wyoming

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[79] Lucius S. Storrs, *The Rocky Mountain Coal Fields* (Washington: Government Printing Office, 1902) 421.: in Storrs, Lucius S. papers, Reports 1897-1903; P1554; Minnesota Historical Society.
[80] Freese, *Coal*, 137.; Smil, *Energy in Nature and Society*, 208, 220.; For statistics on the Rocky Mountain region's production of coal in 1900, see: Storrs, *The Rocky Mountain Coal Fields*, 468-471.

produced 19,407,843 short tons of coal worth $29,279,398.[81] To illustrate this in international context, the author stated that in 1907 "Great Britain's production of coal…was 267,828,276 long tons, or 299,969,669 short tons, and Great Britain is the second coal-producing country of the world. The coal production of the United States in 1907 exceeded by 180,480,373 short tons, or more than 60 per cent, that of the British Isles. It was more than double that of Germany, and was equal to 40 per cent of the total coal production of the world."[82] In the first decade of the twentieth century, coal production doubled due an energy hungry American economy.[83]

The plentiful coal resources of Montana, Wyoming, North Dakota and Colorado were also the focus of a number of studies by the United States Geological Survey (USGS). According to the USGS, the year 1909 saw Montana exceed previous production records due to "the revival of the metal-mining industry and to bountiful crops, which brought generally prosperous conditions throughout the state."[84] Coal tonnage estimates as of 1909 indicated that Montana's coal reserves were about 303 billion short tons of which 0.015% had been mined to that point.[85] In 1913 Montana

[81] Letter from Horace V. Winchell to Louis W. Hill; 132.E.18.6.F; Great Northern Railway Company Records. Minnesota Historical Society.
[82] Great Northern Railway chief geologist Horace V. Winchell quotes from a United States Geological Survey Press Bulletin, Special #4 of June 17, 1908 – by E. W. Parker: Letter from Horace V. Winchell to Louis W. Hill, June 24, 1908; 132.E.18.6.F; Great Northern Railway Company Records. Minnesota Historical Society.
[83] Gardner and Flores, *Forgotten Frontier*, 100.
[84] United States Geological Survey, "Coal Mining in Montana in 1909," Press Bulletin No.438, December 19, 1910.
[85] United States Geological Survey, "Coal Mining in Montana in 1909," Press Bulletin No.438, December 19, 1910.

broke their production record once again due to "an influx of settlers into the state, which resulted in an increased demand for domestic coal."[86]

The ancient origins of the coal resources were often explained in these USGS bulletins. In 1913, the USGS noted the source of many of Montana's deposits in a press release titled "Coal in Ancient Lake Beds" that described the nature and uses of the state's resources.[87] Wyoming's coal resources were also known to be quite ample. In 1912, "[t]he United States Geological Survey estimate[d] the quantity of coal in the ground in Wyoming as exceeding that of any other State in the Union, with the possible exception of North Dakota."[88] As of 1912, Wyoming was forecasted to overshadow Colorado in coal production with its 424 billion short tons of coal resources of which only 0.034% had been extracted.[89] North Dakota's resources were estimated at 500 billion short tons, remnants of the tropical conditions of the Cretaceous and Tertiary periods.[90] Like the paleontologists and geologists who will be discussed in the following chapters, a 1913 USGS press bulletin vividly described the ancient scene:

> During the remote period of the earth's history known as Cretaceous time North Dakota, along with the rest of the Great Plains region, was submerged beneath an interior sea…The fossils that have been found in the Bismarck quadrangle show that as many as 400 species of plants lived at this early time, among them being a Sequoia which is related to the giant redwood of California and the remains of which have been preserved in the rocks. During this period of mild climatic conditions when swamp

[86] United States Geological Survey, "Montana Breaks Coal Record," Press Bulletin, July 16, 1914.
[87] United States Geological Survey, "Coal in Ancient Lake Beds," Press Bulletin No. 134, Sept-Oct., 1913.
[88] United States Geological Survey, "The Coal Resources of Wyoming," Press Bulletin No. 65, July-Aug. 1912.
[89] United States Geological Survey, "The Coal Resources of Wyoming," Press Bulletin No. 65, July-Aug. 1912.
[90] United States Geological Survey, "The Coal Resources of Wyoming," Press Bulletin No. 65, July-Aug. 1912.

> vegetation flourished great land reptiles such as dinosaurs were abundant, especially the massive Triceratops, which must have roamed in large numbers along the shores of lake and swamp.[91]

The USGS explicitly indicated that the West's coal resources were built on this former lush landscape that had once brimmed with exotic life. Anyone reading these documents would undoubtedly come away with knowledge of the immense power embedded in the West and a sense that the region had a long, evolving history.

The western railroads helped to exploit these ancient resources, the products of watery worlds. This fossil fuel fit into the network of American industrial society like a keystone. The process of energy intensiveness and national expansion built from ever-increasing physical power was self-reinforcing. Thus, railroads helped to make coal an important fuel, and coal in turn helped fuel westward expansion on iron rails. Energy transitions of this magnitude are jarring and result in societies formulating new visions for how they see their world.[92] Coal began to fuel the railroads and America's industrial machines making it possible to travel distances and perform tasks that would have previously taken far greater time and human energy to accomplish. Americans now had to struggle to make sense of a world that was now smaller and faster.

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[91] United States Geological Survey, "Geologic Survey in North Dakota," Press Bulletin No. 55, May 24, 1912.

[92] For an example of how this occurred on the western plains when Native Americans used horses to tap into the energetic fertility of the soils, see: Elliott West, *The Contested Plains: Indians, Goldseekers, & the Rush to Colorado* (Lawrence, KS: University Press of Kansas, 1998), 51, 332-333.; For a discussion of what Vaclav Smil referred to as "Fossil-Fueled Civilization" and "The Great Transition," see: Smil, *Energy in World History*, 157-222.

The First Transcontinental: Coal and the Union Pacific Railroad

The first railroad to take full advantage of the energy wealth embedded in the West was the Union Pacific Railroad, the first of the transcontinentals.[93] In the view of Eugene McAuliffe, a Union Pacific Coal Company president and later president of the American Institute of Mining and Metallurgical Engineers, it was the "savage Blackfeet" who controlled the northern passages to the West that pushed the route southward into these paleo-treasures.[94] While coal was surely a treasure of the industrial age, his version of coal's story was at its heart a tragedy. In McAuliffe's 1931 book *The Romance and Tragedy of Coal*, he sought to educate his miners as to the history of their trade.[95] This history, at first published in the Union Pacific Coal Company's employee magazine, was no light subject:

> The way of coal has been a *via dolorosa* from the beginning. Fraught with more significance than any other mineral or manufactured product in the world, resting as it does at the very foundation of our social and industrial fabric, its story is one of trial, trouble, and human suffering. Moments of riotous intoxication, it is true, have appeared from time to time, such, however, were forever followed by yet longer periods of human suffering.[96]

McAuliffe made his living from his knowledge of coal mining and recognized how vital it was to America's industrial prosperity. He ended his piece with hope that the future held revisions to current policies, especially the dangers imposed upon coal miners who

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[93] For a complete history of the Union Pacific, see: Klein, *Union Pacific*.
[94] McAuliffe, *History of the Union Pacific Coal Mines*, introduction.
[95] Eugene McAuliffe, *The Romance and Tragedy of Coal* (Omaha, NE: The Colonial press, 1931), 5.
[96] McAuliffe, *The Romance and Tragedy of Coal*, 11-12.

ensured that coal could continue to aid in "the creation of the 'Land of Opportunity', America."[97]

Coal was an indispensable resource for the Union Pacific and the managers directed their lines in order to take advantage of rich western resources in Wyoming.[98] Given the scarcity of wood fuel along this route in the West, McAuliffe later stated, "[t]o operate a trans-continental railway fuel was an absolute requirement in 1864, and every mile of the proposed location was assiduously searched for coal by geologists and engineers."[99] Coal was also sought because by 1868, according to former vice president of operations for the Union Pacific Coal Company George B. Pryde, "it became necessary to provide a source of fuel more stable and efficient than the wood then used in the locomotives."[100] Since it was also the settlers along the line that needed coal in the treeless West, the Union Pacific Railroad considered it their responsibility to locate and provide fuel for domestic use at reasonable cost.[101] To obtain this coal and their pay of sixty to seventy cents per ton, men went into "a new frontier to be conquered, a black perilous frontier that lay beneath the desert surface of southern Wyoming."[102] By mining this coal and providing jobs for miners, Pryde wrote, the Union Pacific Railroad and the Union Pacific Coal Company "has played a great part not only in the development of southern Wyoming, but in the Western part of the United States during that period."[103] Pryde was congratulatory of the company's contribution to the community by "furnishing

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[97] McAuliffe, *The Romance and Tragedy of Coal*, 97.
[98] Bryans, "A History of Transcontinental Railroads…", 31.
[99] McAuliffe, *History of the Union Pacific Coal Mines*, 11.
[100] Pryde, "The Union Pacific Coal Company," 191.
[101] McAuliffe, *History of the Union Pacific Coal Mines*, 13-14.
[102] McAuliffe, *History of the Union Pacific Coal Mines*, 159-160.
[103] Pryde, "The Union Pacific Coal Company," 193.

a large payroll" and paying taxes that contributed to schools, businesses, and municipal governments.[104] This portion of Wyoming was clearly built on the former fertility of the deep landscape.

The Union Pacific was also proud of its discovery of the coal wealth that underlay Wyoming. They were so proud that they sent a six ton semi-rectangular chunk of coal to the 1904 World's Fair in St. Louis.[105] The Union Pacific was also a good example of the cosmopolitanism and diversity that the railroads and coal mining brought to the West. The coal mines of the Union Pacific were populated with British, Chinese, Japanese, Finnish, Italian, German, French, Austrian, Bohemian, Canadian, Croatian, Dalmatian, Danish, Greek, Irish, Hungarian, Lithuanian, Polish, Russian, Scottish, Spanish, Swedish, and Welsh miners.[106] Regardless of their ethnicity, these miners knew at least something of the geological past of the coal seams through the fossilized remains embedded in the walls of their place of employment and trapped in the products of their days work.[107] As the mining manuals of Chapter 2 testify, the alien nature of these remains of former paleo-environments would have been difficult and dangerous to ignore.

While they were experiencing ancient environments in the depths of the earth, the miners had to face the harsh realities of parched western landscapes once they emerged from the mines. They made enhancements to their above ground abodes. The conclusion

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[104] Pryde, "The Union Pacific Coal Company," 193.
[105] McAuliffe, *History of the Union Pacific Coal Mines*, 135; Another example of a similar display was a five and a half ton block of coal displayed at the Denver Fair in the early 1870s taken from Marshall's Mine near Golden City.: Rossiter, *Statistics of Mines and Mining*, 378.
[106] McAuliffe, *History of the Union Pacific Coal Mines*, 162-164.
[107] Andrews, *Killing for Coal*, 135.

to the 1940 Union Pacific coal mine history addressed the environmental improvements that these miners came to experience as the mining towns came of age in the West.

> Wyoming, especially in the desert portion, where the Company's mines are located, in addition to resting at a high elevation…suffers frequent high winds, making living uncomfortable for people of a nervous temperament, more so when their minds are not happily occupied, a situation which has been materially helped by a more liberal supply of water, making possible trees, grass and flowers.[108]

The areas around the mines were reclaimed because of the presence of coal and by the power of coal. McAuliffe did not detail how this process of applying a "more liberal supply of water" was accomplished, but it can be assumed that it was done through irrigation derived from nearby water sources. Because of the effects of the area's aridity and wind on "a nervous temperament" or simply those settlers who yearned for farmable land and foliage, the region also had to be boosted not as it was, but as it could be. It was well-known that many regions in the West suffered from the lack of photosynthesizing foliage, and the region still labored under the moniker of the "Great American Desert," so the Union Pacific boosted its lands with assurances of abundant local fuel sources.[109] In a region rich in energy resources derived from long-dead foliage, a new land could be built where almost anything was possible.

The early explorations for coal along the Union Pacific line also note the promise of coal. In 1864, geologist James T. Hodge reported on the coal and iron resources of the Rocky Mountains for the Union Pacific. Hodge was concerned about energy and remarked "[t]hough deficient in forests, the lack of wood will be compensated by the

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[108] McAuliffe, *History of the Union Pacific Coal Mines*, 262.
[109] Bryans, "A History of Transcontinental Railroads…", 89.

abundant supplies of mineral coal, the existence of which has already been detected, even to the southern portions of Colorado."[110] Hodge was on the constant lookout for fossils so that he could identify geological ages and follow the stratigraphy of the West.[111] While examining layers of rock he believed to be above a coal seam, Hodge found:

> fossil [s]hells, the substance of which is sometimes well preserved. They are recognised by Prof. Hall as belonging to the genera, cardium, cucullea, mactra, nuncula, tellina, and ammonite; thus designating the formation to be as old as the cretaceous period. The deciduous leaves in the fire-clay determine the coal, or rather lignite beds, as belonging to the same formation.[112]

Overall, Hodge's exploration for the Union Pacific was a success. With the help of fossils, he found and could follow ample reserves of coal. Hodge also had some specimens of coal he collected examined by botanist, chemist, and geologist Dr. John Torrey. In his assessment of the coal collected by Hodge, Torrey stated:

> In calorific power the Rocky Mountain coal may be placed between dry wood and bituminous coal, and therefore it is a most valuable fuel, especially where bituminous coal and anthracite are not likely ever to be found, and fire-wood is difficult to procure.[113]

The Rocky Mountain region, Torrey concluded, would provide good fuel for smelting iron and for locomotives and that "the discovery of such extensive beds of a good mineral fuel is of the highest importance to the section of country in which they occur."[114]

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[110] James T. Hodge, "On the Coal Deposits in the Rocky Mountains," in *Union Pacific Railroad: Report of James T. Hodge, Esq. Geologist* (New York: Wm. C. Bryant & Co., Printers, 1864), 14.
[111] Hodge, "On the Coal Deposits in the Rocky Mountains," 13.
[112] Hodge, "On the Coal Deposits in the Rocky Mountains," 11.
[113] Hodge, "On the Coal Deposits in the Rocky Mountains," 19.
[114] Hodge, "On the Coal Deposits in the Rocky Mountains," 19.

In 1869, a Union Pacific representative brought this geologic knowledge to the public through the *Nebraska Advertiser* newspaper. In an article titled "The Coal Fields of the Trans Missouri," the author stated, "it is a matter of interest and wonder as to the origin and history of these immense coal formations." Through the geologic ages of the Earth, it had undergone colossal changes. "The earth in those pre-historic days was undergoing such changes under the hand of the creator," the author explained, "that the earth of the carboniferous age, with its atmosphere, its land and waters, its animal and vegetable life was essentially another earth from the tertiary age." For the author it was proper to divide history into the "pre-historic and historic." When looking into the pre-historic West, "[w]e enter a new world…Instead of the dry and parched earth, we see vast lagoons and marshes. In place of the present stunted vegetation we find a gigantic tropic verdure." The author was aware of these changes because of the fossils "handed down to us on the pages of this Coal book." And this book was huge according to the author. "Enough is known of its quantity," he stated, "to pronounce it inexhaustible for thousands of years." For the passenger on the Union Pacific the coal measures were plain to see and the settler could rest assured that they would have abundant fuel to warm their hearths into the distant future.[115]

In 1872, a federal assessment of the Wyoming lands stated, "[t]he most promising of the mineral resources of this Territory must be confessed to be the immense coal deposits, which extend for nearly three hundred miles along the line of the Union Pacific Railroad."[116] In the treeless regions of the arid West, coal was of utmost importance to

[115] H. Lathan, "The Coal Fields of the Trans Missouri." *Nebraska Advertiser*, June 10, 1869.
[116] Rossiter, *Statistics of Mines and Mining*, 333.

settling the land and moving locomotives across its dusty ground. The West had become less of a barrier to settlement because of its verdant past entrapped beneath the ground. The Union Pacific began to prove it was possible to profitably exploit these resources and tame the Great American Desert.

James J. Hill's Railroad and Western Coal

Railroad magnate James J. Hill sought to build the future of the West on his coal-fueled rails. The success of the Union Pacific in completing its transcontinental tracks in 1869 did not dampen Hill's ambition to outcompete the original. In the late nineteenth century, Hill's coal acquisitions outcompeted Union Pacific coal deliveries from Rock Springs, Wyoming, in supplying the copper kingdom of Butte, Montana.[117] By 1901, Hill had also acquired the Chicago, Burlington & Quincy Railway Company (CB&Q) that had rail lines running through Wyoming, encroaching on the territory of the Union Pacific.[118] That same year, correspondence from CB&Q's president George B. Harris to Hill revealed the race to access Wyoming's energy deposits. The letter began by stating that the railroad had been considering more extensive inroads into central Wyoming because of coal. Harris stated, "[t]he territory is valuable, and particularly so in that about 125 miles west of our present terminus in Guernsey, there has been found a body of coal of fine quality, very much like that also found at Rock Springs on the Union Pacific Railroad." A slight wrinkle in the plan involved the nature of the Union Pacific Railroad federal land grant. The coal lands were on alternating sections between those owned by

[117] Bryans, "A History of Transcontinental Railroads…", 203.
[118] Michael P. Malone, *James J. Hill: Empire Builder of the Northwest* (Norman, OK: University of Oklahoma Press, 1996), 207-208.; Albro Martin, *James J. Hill and the Opening of the Northwest* (New York: Oxford University Press, 1976), 487-491.; Martin, *Railroads Triumphant*, 28-29.

the Union Pacific. It would therefore be "very difficult for a person owning only the alternate sections to work continuous veins to a profit." Yet, Harris thought it worthy of consideration if a rail line could be built to move the coal accessed in the separate sections.[119]

In the early twentieth century Hill had become somewhat of a celebrity pundit and a sought after speaker.[120] His 1909 book *Highways of Progress* was a thoughtful and well-supported reflection on the progress of the American nation. The book was well received and largely mirrored the views of his fellow Americans.[121] Hill began by expressing a linear view of history where:

> Nations, like men, are travelers. Each one of them moves, though history, toward what we call progress and a new life or toward decay and death. As it is the first concern of every man to know that he is achieving something, advancing in material wealth, industrial power, intellectual strength and moral purpose, so it is vital to a nation to know that its years are milestones along the way of progress.[122]

Hill was celebratory of the "progress" made by the American nation, but also cautious in his prospects for the future. He applauded the use of natural resources, but reminded his readers that these resources require intelligently applied conservation and that others are exhaustible.

Hill's thoughts on the resources most exploited by railroads – timber, coal, and iron – provide an example of his views. He saw the stripping of the Rocky Mountain's

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[119] Letter from George B. Harris to James J. Hill, December 27, 1901. James J. Hill Papers, 20.C.5.3. Minnesota Historical Society.
[120] Malone, *James J. Hill*, 192.; Martin, *James J. Hill*, 557.
[121] Malone, *James J. Hill*, 193; Martin, *James J. Hill*, 558.
[122] James Jerome Hill, *Highways of Progress* (New York: Doubleday, Page & Company, 1910), vii.

forest wealth as a problem in need of fixing through conservation and reforestation efforts. However, Hill was more concerned about the exhaustible resources "which no repentance and no ingenuity can restore or replenish." Ultimately, he was ambivalent about America's hurried exploitation of its mineral resources:

> The two great resources of the under earth, economically speaking, that are indispensable to human comfort and growth, are coal and iron. Our inheritance of these was princely. The most wonderful achievement of this age is the incredible activity with which we are exhausting them…But the fact of the future is not doubtful. No dependable authority gives more than a century of life to our main available coal supply…Not merely our manufacturing industries, but our whole complex industrial life, so intimately built upon cheap iron and coal, will feel the strain and must suffer realignment. The peril is not one of remote geologic time, but of this generation.[123]

There was a degree of contradiction in Hill's statements that encouraged conservation and prophesized an inevitable end to the key resources of modern life, and yet he approved of the fact that these resources had been energetically exploited.[124] Hill saw America's salvation in the soil which could be replenished if managed wisely.[125] His Jeffersonian faith in agriculture will be addressed in Chapter 8. For now it is enough to consider his assessment of the importance of coal to industrial civilization. No doubt Hill sought to justify his life's work in helping to settle arid regions of the American West and exploit its coal and iron resources.[126] Due in part to the iron rails that he helped to build, coal and iron were becoming ever-more scarce, and Hill believed, "civilization, so far as we can now foresee, will suffer as man would suffer by the gradual withdrawal of the air

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[123] Hill, *Highways of Progress*, 10-13.
[124] Malone, *James J. Hill*, 195.
[125] Hill, *Highways of Progress*, 15.
[126] Bryans, "A History of Transcontinental Railroads…" 65, 117-118.

he breathes."[127] However, the agricultural life that he helped to encourage for the western migrant, and that he believed would serve to save the nation from destruction, was built on coal.

Hill began his interest in energy in the wood fuel business, but quickly realized that post-Civil War America was hungry for the greater power granted by coal.[128] However, later in his role as railroad magnate he did not abandon the use of wood fuel in powering his railroad if it was practical.[129] His dealings in the coal business yielded profits and knowledge that he would use in building his western railroad empire. Hill's coal money provided the seed for his initial entry into railroading, and his knowledge of the nature of coal and the coal business allowed him to build successful lines and settlements dependent on the energy source.[130] Practical coal geology became a subject of study for Hill who hungrily consumed coal literature pertaining to its chemical, geological, and economic nature.[131] Education in geology enabled Hill to evaluate the reports of the geologists he sent out to assess coal lands.[132] As a result, Hill could not have been unaware of the significance of the Cretaceous and Tertiary periods in providing the basis for his agricultural dreams in the West. While it is only a half-truth that Hill built his transcontinental without the aid of a federal land grant, since his efforts were supported by a 2.46 million acre grant from the territorial legislature who were

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[127] Hill, *Highways of Progress*, 311.
[128] Malone, *James J. Hill*, 22-23; Martin, *James J. Hill*, 88-93.
[129] Letter from James J. Hill to H.P. Breed, General Superintendent, July 21, 1883; James Hill Letterbooks. StPM&MRy Letterbook, 7:212 (4/23/83-2/13/85): Minnesota Historical Society.; Letter concerns using as few coal burners as possible if there is wood available along the line.
[130] Martin, *James J. Hill*, 92-107; Malone, *James J. Hill*, 23-24; Bryans, "A History of Transcontinental Railroads…", 179.
[131] Martin, *James J. Hill*, 93.
[132] Bryans, "A History of Transcontinental Railroads…", 179.

given it by the federal government, the grant did not extend beyond the Red River Valley in North Dakota.[133] The lack of a land grant beyond the Red River Valley required Hill to use his geological knowledge of coal to evaluate and seek out the best resources for his tracks and town-sites in places like Montana Territory.[134] Hill's Great Northern Railway had many studies commissioned to determine the coal wealth of the West for the purposes of use as fuel and the geography of track construction.[135]

Sand Coulee Coal Company serves as a prime example of how Hill's geological knowledge and "Empire Builder" skills were put to use.[136] It was not uncommon for men to attempt to interest Hill in developing lands in the West. Before Sand Coulee, a man named Hugh O'Donnell made independent investigations into coal resources that could benefit Hill's enterprise. Certain that he would find coal and that he and Hill would be close partners, he wrote Hill, "[w]ill mark whatever I find the same until further orders – for I am bound to get a RR to 640 acres of coal land before I stop." In the same letter, he located a seam so well situated that "you could load up a RR. train right out of the bank." O'Donnell requested that Hill keep his reconnaissance a secret and asked if he could have a pass for the railroad in order to continue his prospecting.[137] He was granted these passes

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[133] Malone, *James J. Hill*, 33; John B Rae, "The Great Northern's Land Grant," *The Journal of Economic History* 12, no. 2 (1952).
[134] Bryans, "A History of Transcontinental Railroads…", 209; Malone, *James J. Hill*, 150.; Public Relations Department, "Condensed History: Great Northern," 132.G.2.9 (B), Minnesota Historical Society. 2.
[135] Bryans, "A History of Transcontinental Railroads...".; For the history of the GNRR, see: Ralph W. Hidy, Muriel E. Hidy, Roy V. Scott, and Don L. Hofsommer, *The Great Northern Railway: A History* (Boston, MA: Harvard Business School Press, 1988).; Claire Strom, *Profiting from the Plains* (Seattle, WA: University of Washington Press, 2003).
[136] Bryans, "A History of Transcontinental Railroads…", 170, 183-207.
[137] Letter from Hugh O'Donnell to James J. Hill, October 3, 1883. James J. Hill Papers, 20.A.3.2. Minnesota Historical Society.

to continue his search for coal with the help of a Native American, but nothing came of this venture.[138]

The undertaking advanced by Paris Gibson, later a Montana Senator and enterprising sheep rancher and wool purchaser, was far more fruitful.[139] In the 1880s, Gibson played a significant role in heightening Hill's interest in Montana. For example, Gibson attempted to interest Hill in present day Great Falls, where he predicted a city would rise to rival Minneapolis, Minnesota. In his 1914 text *The Founding of Great Falls*, Gibson recalled his initial vision of his town: "The scenery, composed of valleys and rivers, flanked by smoothly rounded table lands, formed a picture never to be forgotten. I had looked upon this scene for a few moments only when I said to myself, here I will found a city."[140] Gibson then decided he would contact Hill and give him "much information as to the extent and availability of the water-power as well as to the coal and other useful minerals immediately tributary to it."[141] In July of 1881, Gibson wrote Hill that he had found, "the most important part of Montana both as regards stock + mineral resources."[142] Hill was soon hooked and they entered into a partnership where he backed Gibson in purchasing the land and valuable sites to create the town of Great Falls.[143]

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[138] Bryans, "A History of Transcontinental Railroads…", 181.
[139] For more information on Paris Gibson, see: Paris Gibson, "Paris Gibson Reminiscence, 1914," Montana Historical Society Research Center, SC2172, Manuscript, 1914.; Richard B. Roeder, "A Settlement on the Plains: Paris Gibson and the Building of Great Falls," *Montana: The Magazine of Western History* 42, no. 4 (1992): 4-19.; Paris Gibson, *The Founding of Great Falls*: *And Some of Its Early Records* Minnesota Historical Society. F739.G78 G52 1914.
[140] Gibson, *The Founding of Great Falls*, 8.
[141] Gibson, *The Founding of Great Falls*, 11.
[142] Letter from Paris Gibson to James J. Hill, July 31, 1881. James J. Hill Papers, 20.A.2.6. Minnesota Historical Society.
[143] Roeder, "A Settlement on the Plains: Paris Gibson and the Building of Great Falls," 7.

Initially it was the waterpower that could be generated from the falls that interested Hill and made him consider the possibilities of industrial development in Montana.[144] However, without sufficient high-quality coal prospects to outcompete Bozeman's coal fields, Hill was reluctant to build a line to Great Falls.[145] Gibson knew this, and he realized that without a railroad connection his town was doomed. After sending a series of geologists and personally reviewing the regions prospects, Hill agreed to begin making plans to connect his line to Great Falls and the Sand Coulee coal field.[146] The year 1886 saw these plans begin to unfold. That same year, a longitudinal section drawing of the Sand Coulee coal field showed that the Cretaceous strata from the Dakota Group No. 1 contained fossilized fern and fish remains [Figure 29].[147] Along with its floral origins, knowledge of the presence of fossilized marine creatures in Montana coal percolated through the strata of society to GNRR president James J. Hill and soon-to-be Senator Paris Gibson. Both knew that marine fossils were being used to signify Cretaceous coal, exposed through coal mining and railroad construction. With this biostratigraphic knowledge, they were better equipped to predict the geographic extent of coal deposits in that formation. Hill would even inform friends where they could find rich

[144] Martin, *James J. Hill*, 334.
[145] Bryans, "A History of Transcontinental Railroads…", 190-191.
[146] Bryans, "A History of Transcontinental Railroads…", 188-195; Martin, *James J. Hill*, 334-338.
[147] "Longitudinal Section of Strata Map—Sand Coulee, Great Falls, MT," Colin Napier, June 15th 1886, Folder 2; 132.D.18.9.B. GN Branch Line. Great Northern Railroad Records. Minnesota Historical Society.

fossil beds.[148] Undoubtedly, Hill understood the significance of the geology of the West to the success of his ventures.[149]

Professor J.S. Newberry of the Columbia School of Mines, the same geologist who Hill employed to initially evaluate the coal field, indicated in 1889 that he had found Cretaceous fossil plants in the Great Falls coal field.[150] The following year, the Great Northern Railway line construction between Helena and Great Falls cut into another deposit revealing more fossilized flora, later explored by paleontologists Newberry, F.H. Knowlton, C.A. Peale, and W.H. Weed.[151] This Cretaceous coal allowed the Sand Coulee Mine to become a commercial producer by 1888, but due to the nature of its deposition and the incompetence of the mine's manager it was initially plagued by impurities that eventually forced the mine to close.[152] While in operation from 1888 to about 1902, the Sand Coulee mine fueled smelters in Helena, Butte, and Anaconda and supplied about 40% of the railroad's fuel requirements.[153] The coal also powered local economies and fueled domestic and industrial use for flourishing communities.[154] The railroad, powered by western coal, was settling the West. However, by the turn of the century the Sand Coulee coal seams had been exploited to the point where it was not profitable to haul the

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[148] Letter from Paris Gibson to James J. Hill. March 31,1886. Folder 20.G.3.3. J. J. Hill Papers. General Correspondence. Minnesota Historical Society.; Letter from Charles Ellis to James J. Hill. May 8, 1898. Folder 20.B.5.5. J. J. Hill Papers. General Correspondence. Minnesota Historical Society.
[149] For Hill's recognition of the importance of coal and its exhaustibility, see: Hill, *Highways of Progress*, 11, 311.
[150] Cassius A. Fisher, "Geology of the Great Falls Coal Field," ed. United States Geological Survey (Washington, D.C.: Government Printing Office, 1909), 33.
[151] Fisher, "Geology of the Great Falls Coal Field," 33.
[152] Mitzi Rossillon, Mary McCormick, and Mark Hufstetler, Renewable Technologies Inc., "Great Falls Coal Field: Historic Overview," Prepared for Mine Waste Cleanup Bureau: Montana Department of Environmental Quality (June 2009): 22.; Contemporaries considered the coal to be from the lower Cretaceous.; Fisher, "Geology of the Great Falls Coal Field," 50.
[153] Bryans, "A History of Transcontinental Railroads…", 203-206; Malone, *James J. Hill*, 125.
[154] Bryans, "A History of Transcontinental Railroads…", 171.

remaining marginal coal to market. Furthermore, the local water sources had been polluted by the mine to the point where they were unusable for even industrial purposes. The coal at Sand Coulee was of diminishing quality, the water was poisoned, and as a result alternatives needed to be considered.[155]

The Cretaceous once again came to the rescue. Since geology knows no national boundaries, Hill pushed north and sought the Cretaceous coals of Canada. In 1888 he was not yet convinced of the feasibility of crossing the border and still assumed that coal was extremely abundant in Montana. But during that year he was handed a prospectus on Crows Nest Coal Company's coal resources just across the international border in British Columbia north of what is now Glacier National Park. Hill's conclusion was that "[t]he extraordinary thickness of the seams with the apparent good quality of the coal makes the district a very valuable one so far as its capacity to produce large quantities of good fuel at low prices is concerned, and I see no reason why coal should not be mined quite cheaply in that section." However, he also noted, "[s]outh of the International boundary line there seems to be all along the eastern slope of the Rocky Mountains large and numerous deposits of similar coals." Because of his recent commitments to Paris Gibson and the coal prospects of his new town, the Sand Coulee coal mine was on his mind when he stated, "[n]ear Great Falls, Montana, the area of one field seems to be thirty miles wide and sixty miles long." Hill had no need for Canadian Cretaceous coal because

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[155] Rossillon, McCormick, Hufstetler, Renewable Technologies Inc., "Great Falls Coal Field," 29; For more information on Sand Coulee, see: Delta Engineering, "Sand Coulee/Belt Coal Field: Reclamation - Engineering Study Cascade County, Montana," (Great Falls, Montana, 1983); George Irvin Erickson, "A History of Sand Coulee, Montana 1880 through 1900" (MA Thesis, Montana State University, 2008).; Giannini, *A History of Sand Coulee*.; Mary Seknyak Surmi, "Mary Seknyak Surmi Interview, 1983 Feb. 15," Montana Historical Society Research Center, OH 469, 1983.; Bryans, "A History of Transcontinental Railroads…", 183-207.

"[t]hese local fields will supply all the demand for this class of coal in Montana east of the Rocky Mountains and probably for some distance west." He was happy to leave it to the Canadian Pacific Railway to exploit this resource.[156] Later that year he confirmed his statement in another letter in which he asserted his faith in the huge high-quality coal fields of Montana, and expressed the futility of transporting coal across the border; "it would be carrying coals to Newcastle to attempt to haul coal from north of the boundary into the United States."[157] Hill's hesitance evaporated at the turn of the century as Sand Coulee's coal increasingly ran afoul with his customers and locomotive engineers. [158] He needed another avenue into the fossilized energy of the Cretaceous.

Hill had already been making inroads into British Columbia by that time and concerns with crossing the international border had faded from memory. Knowing the value of the Cretaceous deposits at Crow's Nest Pass, Hill quickly made his move to secure controlling interest in Crow's Nest Coal Company.[159] This Cretaceous coal region also soon proved a bastion for fossil finds. In 1901 while investigating the region around Crow's Nest Pass, members of a Canadian Geological Survey team were engaged in fossil collecting and "brought home a fine collection of the remains of Upper Cretaceous reptiles, [including]…two species of tortoises."[160] The Cretaceous of Crow's Nest Pass was further explored by other paleontologists during the years 1900 and 1901, when "[t]hirty-six fossils (plants, mollusca, corals, &c.)" a "[w]ing of [a] fossil insect," and

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[156] Letter from James J. Hill to Col. C.B. Lamborn, April 14, 1888. JJH Letterbook, 4/12/88 – 2/7/89, p. 21: M458 Reel 11. Minnesota Historical Society.
[157] Letter from James J. Hill to T. Mitchell, November 6, 1888. JJH Letterbook, 4/12/88 – 2/7/89, p. 542: M458 Reel 11. Minnesota Historical Society.
[158] Bryans, "A History of Transcontinental Railroads…", 203-208.
[159] Malone, *James J. Hill*, 174-175; Martin, *James J. Hill*, 592-593.
[160] Geological Survey of Canada, *Summary Report - Geological Survey Department for the Year 1901* (Ottawa, Canada: S.E. Dawson, Printer to the Queen's Most Excellent Majesty, 1902), 4.

"[e]ighteen specimens of fossil plants from the coal-bearing rocks of the Kootanie series [Lower Cretaceous]" were found.[161] The coal measures brought Hill the fuel he needed for his locomotives, and the railroads brought scientists to explore the mines and surrounding region for the advancement of science. Fossils, fossil fuels, coal mining, and the railroads were united in a web of interdependence resulting in scientific discovery industrial development across the West.

By the early-twentieth century, there was increased urgency in obtaining coal lands along the rail lines of the GNRR and throughout Montana. A 1911 piece of correspondence from the GNRR Geology Department stated, "I think it is a good idea for the Company to control all the coal lands in Montana it possibly can…coal is going to be a scarce commodity."[162] The railroads required detailed knowledge of the products of the West's paleo-environments to ensure steady supplies.[163] Aside from employing their own geologists, throughout the late nineteenth and early twentieth centuries, the railroads relied on scientific surveys of the West's resources in order to locate coal. Furthermore, the transcontinental railroads connected the remote regions of the West to the eastern centers of science, and those pursuing the study of the geology and paleontology rode on these rails to expand their knowledge of Earth's history.

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[161] Geological Survey of Canada, *Summary Report - Geological Survey Department for the Year 1900* (Ottawa, Canada: S.E. Dawson, Printer to the Queen's Most Excellent Majesty, 1901), 184-185; *Summary Report - Geological Survey Department for the Year 1901*, 254.

[162] Letter, coal lands in Montana, to Mr. F. S. Dalrymple, August 10, 1911; 132.C.2.3.B; Geology Department, 2253; Great Northern Railway Records, Minnesota Historical Society.

[163] William Stanley Jevons, who famously wrote concerning the exhaustion of coal in England in 1865, made concerns regarding coal scarcity widely known. Not too long after, these concerns entered into the American psyche.: William Stanley Jevons, *The Coal Question: An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of our Coal-Mines* (London: Macmilian and Co., 1865).

The Railroads, Coal, Fossils, and Science in the West: Energizing Visions of Former Worlds

In the Union Pacific's promotional piece, *The Fossil Fields of Wyoming,* A. R. Cook, Professor of Mineralogy at Northwestern University, stated, "[i]t has become a proverb that for a geologist there are three requisites for success: The first is travel, the second is travel and the third is travel."[164] The railroads were willing to facilitate travel for geologists, paleontologists, and survey scientists because their research helped the railroads find deposits of coal. Paleobotanists were particularly interested in exploring the western coal seams because the fossil flora made it possible to more completely reconstruct paleo-environments and paleo-climates. Fossil hunters and vertebrate paleontologists also took advantage of the geologic association between fossils and coal to further their research. The railroads and scientists formed a mutual bond that helped both to achieve their ends as the West was being developed after the Civil War. Coal provided a means to create a clearer picture of the paleo-West and ponder its abundant greenery, unfamiliar creatures, watered landscapes, and tropical climates.

Ferdinand Vandeveer Hayden exemplified the complex role of pragmatic governmental scientist, naturalist, and western booster.[165] His appetite for scientific forays into the West was whetted in the years running up to the Civil War. Hayden thought of himself as an ideal candidate for collecting in the frontier and wished to

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[164] Union Pacific Railroad Passenger Department, *The Fossil Fields of Wyoming* (Omaha, NE: Passenger Department, Union Pacific Railroad Company, 1909), 18.

[165] James G. Cassidy, *Ferdinand V. Hayden: Entrepreneur of Science* (Lincoln, NE: University of Nebraska Press, 2000).; For more scholarship concerning the work of Hayden see: Goetzmann, *Exploration and Empire*.; Mike Foster, *Strange Genius: The Life of Ferdinand Vandeveer Hayden* (Niwot, CO: Roberts Rinehart Publishers, 1994).; Mike Foster, "Ferdinand Vandeveer Hayden as Naturalist," *American Zoologist* 26, no. 2 (1986).

dedicate his life to uncovering the secrets that lay awaiting the fearless explorer-scientist. For example, Hayden wrote in 1853 to Spencer Baird at the Smithsonian that he felt "as though I could endure cheerfully any amount of toil, hardship, and self denial provided I could gratify my strong desire to labor in the field as a naturalist…I am willing to go anywhere, for any length of time and labor with the utmost diligence…I could live as the Wild Indian."[166] After the Civil War, Hayden was successful in taking the helm of what would become the first of many United States Geological Surveys (USGS) of the Territories.[167] The immediate beneficiaries of this first survey in 1867 were the citizens of Nebraska Territory. Hayden had spent some time in that region studying its geology prior to the Civil War, so he knew that settlers and influential men were deeply interested in finding coal. In a letter to Baird, he first intimated that he had found some "petrifactions as Cretaceous fossils," and that he had "started a nucleus for a museum for the Territory" which consisted of a number of the fossils he had collected. "All the citizens of the Territory without respect to party," Hayden explained, "are very desirous of having an early Survey of the Territory." Hayden himself was "convinced that science would be very greatly benefitted" from the survey. In the meantime, he was collecting specimens to advance science, but if he "had time" he "would make some

[166] Letter from Ferdinand Vandeveer Hayden to Spencer Baird, February 16, 1853, Smithsonian Institution Archives. SIARU007002 Box 24 Folder 19. "Hayden, Ferdinand Vandeveer, 1853-1854."
[167] Cassidy, *Ferdinand V. Hayden*, 83.; For example, he wrote to Spencer Baird at the Smithsonian Institution and asked, "[i]f you could induce the Senators from Nebraska to write at once to Gov Saunders, tell them how much it would aid emmigration to have a good scientific report of that region. Write at once do not let Prof. Henry delay a day.: Letter from Ferdinand Vandeveer Hayden to Spencer Baird, March 10, 1867, Smithsonian Institution Archives. SIARU007002 Box 25 Folder 1. "Hayden, Ferdinand Vandeveer, 1867-1869."; Later, Hayden also told Baird that "[t]he most influential men in the Territory say that I shall have the charge of this Survey." Letter from Ferdinand Vandeveer Hayden to Spencer Baird, February November 14, 1854, Smithsonian Institution Archives. SIARU007002 Box 24 Folder 19. "Hayden, Ferdinand Vandeveer, 1853-1854."

money…hunting for coal." He found that "[c]oal is the great desideration of the Territory and people are confident they have it in abundance."[168] A few weeks later, Hayden repeated to Baird that "the great want of fuel leads the people to inquire earnestly whether Nebraska contains Coal."[169] After effectively executing this survey, Hayden succeeded for the next few decades in securing the lead of these government surveys of the western Territories. Central to his success was his attention to the desires of politicians, the railroads, settlers, businessmen, and citizens who wanted useful information for the exploitation of natural resources and agricultural settlement of the region.

In Hayden's "Letter to the Secretary" in his second USGS report, he expressed his faith in the colonizing course of the country. "Never has my faith in the grand future that awaits the entire West been so strong as it is at the present time," affirmed Hayden, "and it is my earnest desire to devote the remainder of the working days of my life to the development of its scientific and material interests, until I shall see every Territory, which is now organized, a State in the Union."[170] Hayden, the consummate pleaser and reserved scientist stated, "[i]t is my earnest pleasure at all times to report that which will be most pleasing to the people of the West, providing there is any foundation for it in

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[168] However Hayden feared that there was little valuable coal in the Territory.; Letter from Ferdinand Vandeveer Hayden to Spencer Baird, February November 14, 1854, Smithsonian Institution Archives. SIARU007002 Box 24 Folder 19. "Hayden, Ferdinand Vandeveer, 1853-1854."; Later, in 1881, Charles Dana Wilber, Nebraska's great promoter repeated some of Hayden's comments concerning coal. Wilber stated, "[t]he supply of coal within the limits of Nebraska, still engages public attention more than any other topic relating to our natural resources."; Charles Dana Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest* (Omaha, NE: Daily Republican Print, 1881), 175.

[169] Letter from Ferdinand Vandeveer Hayden to Spencer Baird, February December 6, 1854, Smithsonian Institution Archives. SIARU007002 Box 24 Folder 19. "Hayden, Ferdinand Vandeveer, 1853-1854."

[170] Ferdinand Vandeveer Hayden, *Preliminary Report of the United States Geological Survey of Wyoming and Portions of Contiguous Territories* (Washington: Government Printing Office, 1872), 6-7.

nature."[171] Hayden's surveys served as a conduit for nature to speak about its potential for settlement. A stickler for rapid publication for public use, Hayden noted in a June 4, 1870, letter to Spencer Baird that "[n]othing is to be sent to any one who will not pledge himself to have a report ready by January 1st 1872."[172] "The object of these reports," in Hayden's estimation, "seems to me to be to bring before the people at as early a date as possible immediate practical results."[173] Indeed, Hayden's goal to use science to promote settlement often outweighed his dedication to accurate work. Hayden defended himself against criticism with his pragmatic belief that the publication of unpolished science for the purpose of rapid western settlement was better than the delayed and digested material that solely served the scientist. Thus, while he was accused of being incompetent and a charlatan, he was nevertheless popular among settlers, capitalists, the railroads, and miners who used his work to profit from the West.[174] Hayden's surveys, while sloppily constructed and inaccurate at times, helped push the cresting wave of settlement across the continent. Embedded in his reports, like fossils in the earth, was the gospel of progress and scientific support for a western landscape of hope made mutable by man and nature.

Success in finding and exploiting coal, however, increasingly depended on developing accurate theories of its creation and deposition. The paleobotanist Leo Lesquereux theorized one of the most accepted and comprehensive theories for the

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[171] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 8.
[172] Marlene Merrill, *Yellowstone and the Great West: Journals, Letters, and Images from the 1871 Hayden Expedition* (Lincoln, NE: University of Nebraska Press, 1999), 63; Cassidy, *Ferdinand V. Hayden*, 205.
[173] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 8.
[174] Richard A. Bartlett, *Great Surveys of the American West* (Norman, OK: University of Oklahoma Press, 1962), 118-119.

formation of coal. According to his 1895 biography, "[i]n his Letters of Explorations in the North, published by the Revue Suisse in 1846, he gives a mature theory of the origin of coal, which has been adopted by all geologists who have studied coal measures."[175] Lesquereux, who described himself as "the historian of our coal fields" in a letter to Hayden, was more than familiar with coal formation and sought some more answers to his paleobotanical questions in the western frontier.[176] In order to study coal formations in the West, Lesquereux maneuvered to work with Hayden. His resulting reports were included in some of Hayden's surveys of the western territories. Like Hayden, Lesquereux believed in the future of the United States, and in the second USGS report, he expressed his faith through coal. In a section titled "The Fossil Plants in Relation to our Present Civilization," Lesquereux stated:

> To say that fossil plants have a relation to our present civilization appears at first sight a paradoxical affirmation. But what is coal? A mere agglomeration of petrified debris of plants. And who at our time could refuse to admit the influence of coal upon our actual civilization? Coal is the great generator of heat, of steam, of force; a potent auxiliary of every kind of enginery. It helps to the construction of our railroads; it brings them to countries which, without it, would remain deserts; and transports

[175] J. P. Lesley, "Memoir of Leo Lesquereux. 1806-1889," in *National Academy of Sciences: Biographical Memoirs Vol. III*, (Washington, D.C.: Academy of National Sciences, 1895), 207; Lesquereux combined childhood and sponsored interest in peat-bogs with paleobotany in the U.S. West to formulate and refine his theory. See also the work of Paul Lucier in which he states Carl Linnaeus knew of the vegetable origin of coal, and that Robert Bakewell had a peat-bog theory of coal formation in 1828, and Henry Darwin Rogers who drew on Bakewell to formulate another peat-bog/in situ theory of coal formation that impressed Charles Lyell and was also foundational. A previous and competing theory was referred to as the estuary theory in which vegetable matter from land was washed into marine bodies for deposition. Uniting the theories became essential to understanding coal formation: Paul Lucier, *Scientists & Swindlers: Consulting on Coal and Oil in America, 1820-1890* (Baltimore, MD: The Johns Hopkins University Press, 2008), 70-107.; See also, John J. Stevenson, "The Formation of Coal Beds. I. An Historical Summary of Opinion from 1700 to the Present Time," *Proceedings of the American Philosophical Society* 50. No. 198 (Jan.-Apr., 1911): 1-116.

[176] Letter from Leo Lesquereux to Ferdinand Vandeveer Hayden, May 17, 1873. Smithsonian Institution Archives. SIARU007002 Box 25 Folder 2. "Hayden, Ferdinand Vandeveer, 1870-1874."

> everywhere, with lightning speed, not only the necessaries of life, but the products of industry essentially due to its active cooperation. Coal is now used everywhere, and is the friend of everybody. It has become an object, not of mere commodity, but of absolute necessity.[177]

Coal was necessary to life and it had humble origins as plant "debris." Happily, in Lesquereux's estimation, the coal measures of the United States were "immense." America's coal bounty was such that "in their conception of the future development of our human race, geographers, historians, philosophers, agree in this idea: that in the United States we have, especially in our coal deposits, the elements for the greatest and most perfect development of the human race."[178] Coal ensured America's greatness.

With the help of those extracting coal from the West, Lesquereux located many sites where he found floral fossils in or near coal formations. In his section titled "Lignitic Formation and Fossil Flora" in the sixth USGS report, Lesquereux's letter of submittal to Hayden credited the parties that made his prospecting possible:

> Allow me sir, to gratefully acknowledge the valuable assistance received from yourself in railroad passes, letters of introduction, &c., still more by information from your former reports, and also to mention the kind assistance offered everywhere to my explorations by the superintendents of mines, the engineers of railroads, the proprietors, &c., who generally manifested interest in my researches.[179]

Lesquereux's research was successful due to the cooperation of the railroads and mines of the West. Of particular interest to railroads in the West was the formation of lignite

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[177] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 375.
[178] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 377.
[179] Ferdinand Vandeveer Hayden, *Sixth Annual Report of the United States Geological Survey of the Territories: Embracing Portions of Montana, Idaho, Wyoming, and Utah; Being a Report of Progress of the Explorations for the Year 1872* (Washington: Government Printing Office, 1873), 317.

coal. Lesquereux therefore devoted a section to the topic, beginning with a quotation from Lyell indicating the principle of uniformitarianism and admitted ignorance of "how little the formation of our combustible material is understood."[180] Owing to his uniformitarianism leanings, what followed was Lequereux's attempt to explain the formation of lignite through the ongoing and known processes of peat formation. However, he admitted that the science of peat formation had been neglected because "[p]eat-bogs have nothing attractive, nothing which speaks at first to an imaginative mind, which charms it and tempts it to investigation. They are like cemeteries, mere resting-places for death."[181] Braving these dreary beds of vegetable death, Lesquereux made his investigations into lignite formation through an observation of peat formation and concluded:

> Nothing is more admirable in nature than the apparently simple process of the formations which have here been briefly reviewed. Nature disposes of the carbonic acid of the atmosphere and of its humidity for the food of the plants which, by a kind of digestion, elaborate it into woody fibers. Under peculiar times and circumstances, where these woody materials are unavailable, it piles them into vast magazines, carefully prepared for a long time in advance, for that purpose. And then, reversing its operation, slowly combining again the water and the carbonic acid of the wood, to return them to the atmosphere as new food for living plants, it constantly improves the value of the stored materials for a future contingency. Man now recognizes the end of this work, enjoys its results, and can but acknowledge in it the disposition of a wonderful Providence.[182]

[180] Hayden, *Sixth Annual Report*, 350.
[181] Hayden, *Sixth Annual Report*, 350-351.
[182] Hayden, *Sixth Annual Report*, 356-357.

Lignite formation, while complicated, was Providential according to Lesquereux. As will be discussed later, it was also related to another form of perceived Providence in its indication of tropical paleo-environments used for boosting the West.

Lesquereux's section titled "On the Fossil Plants of the Cretaceous and Tertiary Formations of Kansas and Nebraska" in the second USGS report affirmed that paleontological science could determine past climates and environments. Fossilized plant matter was vital to revealing paleo-climates because "[a]s vegetation is in absolute relation with atmospheric circumstances," Lesquereux explained, "the fossil plants are, indeed, the written records of the atmospheric and physical conditions of our earth at the epochs which they represent."[183] Botanical paleontology, according to Lesquereux, could paint a complete picture of environments long past. Coal, the fossil fuel that powered transformative technologies in the West was also a prime source of paleo-environmental data. "In the coal formations," Lesquereux specified, "[e]verywhere the vegetable life predominates and attains its widest proportions…The emerged land is marked by a succession of immense low swamps, whose surface is concealed under a thick carpet of creeping plants…[large trees] cover the land with a world of vegetation, which is scarcely now conceivable, even by the wildest imagination."[184] As will be covered later, like Hayden and Richard Smith Elliott, Lesquereux imagined paleo-environments through the fossilized vegetable matter that constituted western coal deposits. This was also the very same resource energizing settlement and powering technological faith in restoring the fallen Eden where coal was formed.

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[183] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 373-374.
[184] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 374.

In the sixth report, to further elaborate the nature of the lignite formation's climate, Lesquereux explained, "[t]he flora of our Lignitic, like that of the Coal epoch, has a number of species, whose affinity is with plants now considered as characteristic of a tropical or subtropical climate. It has been generally argued therefrom that at the time when our combustible minerals were in progress of formation the climate of our country was much warmer than it is now."[185] In this report, the incredible vegetation that predominated during this period that was beyond the scope of the imagination had found an analog in the tropic climates.

The benefit of providing railroad passes to individuals like Lesquereux was that many of his investigations were centered along the rail line and might therefore discover nearby coal deposits.[186] In the section of his report entitled "The Lignite-Deposits Along the Union Pacific Railroad From Cheyenne to Evanston," Lesquereux made direct recommendations for the Union Pacific's coal acquisitions. "It is, nevertheless," Lesquereux reported, "certain that if the coal is not carefully husbanded along the Union Pacific Railroad, there will be great difficulty of obtaining a large supply in a short time to come."[187] Though he was sure not to be too glum in his predictions and stated, "there is for the present more danger of a glutted market than of a scarcity of combustible material, and that for the future the settlements in the valley of the Rocky Mountains, and especially along their eastern base, may rely on a permanent and cheap supply to coal."[188]

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[185] Hayden, *Sixth Annual Report*, 358.
[186] Hayden, *Sixth Annual Report*, 318, 330, 331, 333.
[187] Hayden, *Sixth Annual Report*, 368.
[188] Hayden, *Sixth Annual Report*, 367.

His comments and suggestions helped boost the settlement potential of the West and likely assisted the Union Pacific in management decisions concerning fuel.

Lesquereux's report was not the only one focused on the railroad, fossils, and coal in the sixth USGS report. In the same volume, H. M. Bannister , M.D. wrote a "Report of a Geological Reconnaissance Along the Union Pacific Railroad" which consisted of "an account of a portion of the geological reconnaissance made by Mr. Meek and myself in the coal-bearing formations along the line of the Union Pacific Railroad in the summer of 1872."[189] As mentioned above, western coal also mattered to the railroads and settlers because timber was scarce. Thus, even paleontologists entered into the conversation concerning the shortage of western timber. Paleontologist Fielding Bradford Meek's comments in the sixth USGS report addressed the paucity of timber and the resulting importance of coal in the West. He stated, "when we take into consideration the great scarcity of wood throughout immense areas of this internal part of the continent, the thickness and extent of some of the beds, and their proximity to the Pacific Railroad, it will be readily understood that these mines must be of great value."[190] Thus coal's value was determined by the stark western environment and the construction of the transcontinental railroads.

At the start of the sixth USGS report, the Union Pacific was directly thanked by Hayden for providing "free transportation for nearly all the members of the party."[191]

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[189] Hayden, *Sixth Annual Report*, 521.
[190] Hayden, *Sixth Annual Report*, 449.
[191] Hayden, *Sixth Annual Report*, 9.; Thanks were also given by a number of the individual survey members in their letters of submittal. For example, Cyrus Thomas thanked a number of railroads for their assistance.; Hayden, *Sixth Annual Report*, 275.; In the Fifth USGS Report, Hayden also thanked the Union Pacific for providing reduce rates for shipping the party's freight.; Ferdinand Vandeveer Hayden, *Preliminary Report*

This was clearly a symbiotic relationship, but the work done by Bannister and Meek was not simply coal-prospecting for the railroad. Rather their work focused on fossils found in the coal along the Union Pacific Railroad line. However, as discussed in Chapter 2, fossils demarcate formations and stratigraphy and allow one to trace and predict the extent and location of fossil fuel deposits. The USGS report was a synergetic enterprise which benefitted scientists, the government, boosters, settlers, and the railroads. Coal, timber, agriculture, settlement and the railroads were tightly bound in the industrial economy built upon the ecologies of deep time. The railroads served to bind them ever tighter as they raced across the continent.

The association of coal and fossils was well-known by the late nineteenth century. Paleontologists exploited this association, and it was not only the presence of fossilized tropical flora that demonstrated the plasticity of the past. Marine and fresh water fossils were also connected to coal formations in the West. Demonstrating the importance of marine fossils in identifying formations of coal for the use of the railroad, Meek was sure to state that they found the same oyster in two mines approximately five miles apart.[192] The famed paleontologist Othniel Charles Marsh made note of one such locality in his pocket notebook: "Fossils in layer under coal. Shells only."[193] Similarly, in 1878

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of the United States Geological Survey of Montana, and Portions of Adjacent Territories: Being a Fifth Annual Report of Progress (Washington: Government Printing Office, 1872), 7.

[192] Hayden, *Sixth Annual Report*, 449-450.

[193] Othniel Charles Marsh, Pocket Notebook 2, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).

geologist and fossil hunter Arthur Lakes informed Marsh of a find of fish and marine fossils found in a layer of lignite.[194]

Geologist Walter Harvey Weed's 1893 work for the USGS, titled *The Laramie and the Overlying Livingston Formation in Montana*, made use of this association as well. After referencing the impact of the Cretaceous Seaway on the West, he stated "[t]he occurrence of marine Cretaceous fossils in the Laramie [geologic formation], showing temporary recurrence of salt-water conditions following a considerable period of coal-making depositions is now a well-established fact."[195] Weed also noted that, "[i]n general these coals are valuable fuels, differing materially from the lignites of the east, and are in ready demand throughout the state. They are mined at a number of localities throughout the Bozeman coal field, but elsewhere in this part of the state have not been commercially developed."[196] Also, Weed's collaborator in this report, paleobotanist Frank Hall Knowlton was known for his extensive late nineteenth-century work in Montana. Knowlton's 1892 report titled "The Fossil Flora of the Bozeman Coal Field" studied an area owned by the Bozeman Coal Company. This company contracted with the Northern Pacific Railroad in 1883 and due to quality issues the contract was annulled in 1884.[197] Yet, the paleontological finds of the coal field were of significance. Knowlton stated that

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[194] January 10, 1878; Arthur Lakes Letters and Sketches to O.C. Marsh from Morrison CO. 1877-1879; Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).

[195] Walter Harvey Weed, *The Laramie and the Overlying Livingston Formation in Montana* (Washington: Government Printing Office, 1893), 19.

[196] Weed, *The Laramie and the Overlying Livingston Formation in Montana*, 19.

[197] "Land Committee's Report: January 4th, 1887."; HE2791.N795 N8 No. 234. Northern Pacific Railroad Records. Minnesota Historical Society, 3, 65.; Bryans, "A History of Transcontinental Railroads…", 133; Mines in the vicinity of Bozeman still continued to operate and provide fuel for the Northern Pacific Railroad. For more information, see: Rita McDonald and Merrill G. Burlingame, "Montana's First Commercial Coal Mine," *The Pacific Northwest Quarterly* 47, no. 1 (1956): 23-28.

the specimens were all of the Laramie formation from the Cretaceous period and "at present understood, the flora of the Bozeman Coal Field embraces 43 species. Of this number 3 are regarded as new to science, while a number of others are of exceptional biological interest."[198] The Northern Pacific Railroad and scientists used this coal field for their own ends.

The railroad's proximity to these fields was also a topic of note in the scientific study of western coal resources. 1893 Yale University's Silliman professor of geology and natural history, James D. Dana, stated in his widely read *Manual of Mineralogy and Petrography,* "Coal of the Cretaceous and Tertiary eras constitutes important beds in various parts of the Rocky Mountain region, in the vicinity of the Pacific Railroad and elsewhere."[199] In 1902, geologist for the Northern Pacific Railroad and special writer for the United States Geological survey Lucius S. Storrs, confirmed this in his USGS report on the Rocky Mountains in which he stated, "'[p]ractically all the coal of the Rocky Mountain region is contained in beds of the Cretaceous age."[200] In his report, each coalfield mentioned has a reference to its proximity to the Northern Pacific Railroad, highlighting the importance of the geology of the West to railroad development in the

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[198] F. H. Knowlton, "The Fossil Flora of the Bozeman Coal Field," (Read before the Biological Society of Washington, March 19, 1892).; Knowlton also wrote a piece in 1912 concerning the relationship of paleobotany to geology and how the field reveals former climates. Of particular interest to this analysis, he stated, "[i]n the rocks of this horizon, which now occur on the wind-swept, almost treeless plains of the Dakotas, Wyoming and Montana and thence northward to the valley of the Mackenzie, are found remains of Sequoia, *Taxodium, Thuya, Ulmuts, Populus, Vitis, Platanus, Sapin- dts, Vibalrnumwt, Cordyles, Jutglns, Hicoria*, etc., etc. From this array we feel justified in assuming a cool to mild temperate climate for this early Eocene flora, and further, from the presence of numerous, often thick beds of lignite, that there was a much higher precipitation than at present.": Frank Hall Knowlton, "The Relations of Paleobotany to Geology," *The American Naturalist* 46, no. 544 (1912): 207-215.

[199] James D. Dana, *Manual of Mineralogy and Petrography: Containing the Elements of the Science of Minerals and Rocks, for the use of the Practical Mineralogist and Geologist and for Instruction in Schools and Colleges Twelfth Edition* (New York: John Wiley and Sons, 1893), 357.

[200] Storrs, *The Rocky Mountain Coal Fields*, 422.

West.[201] Coal provided a window through time that granted scientists the ability to recreate past environments through fossils. At times, prospecting for fossils around coal was also quite beneficial to the fossil hunter. Fossil hunter Charles Sternberg's memoir refers to his experience in the Badlands where he and Cope found "many beds of lignite, which makes a good soft coal, and burns readily…All one had to do was drive up the face of the cliff and load a wagon in a few minutes."[202] The lignite provided a readily available fuel supply for field life in close proximity to fossiliferous formations.

Not only was coal useful for advancing civilization and fueling railroads, it provided fuel for the imagination to perceive the past and future of the West. Coal was vital to settling the West and enabled these scientists to travel to these locations via the railroad. The association between the geologic processes of coal and fossil formation brought a diverse group of scientists and fossil hunters into coalfields throughout the West to investigate deep time and benefit from the energy and ancient life resources entombed in the earth. Coal also powered the railroads and affected how Americans perceived time and space and human mastery over the natural world. Both materials generated from the western paleo-environments worked in concert to both foster optimistic dreams of a future West and to make those dreams realities.

Conclusion

American science rode on the rails of the transcontinental railroads fueled by coal. The railroads helped scientists formulate a fuller vision of the paleo-West. Before the

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[201] Storrs, *The Rocky Mountain Coal Fields*, 422-471.
[202] Charles H. Sternberg, *The Life of a Fossil Hunter* (New York: Henry Holt and Company, 1909), 68-69.

Civil War, science in America was in many ways a weak imitation of the high standards of European science. With the completion of the first transcontinental railroad soon after the nation's bloodiest and most divisive conflict, scientists were bequeathed a new avenue for original research. American science advanced rapidly along the rails due to the unprecedented access granted to rapidly explore lands filled with new prospects for research. A continent of data was opened in the West, especially for geologists and paleontologists. The nature of the western environment made for perfect conditions for the practice of these sciences. The arid environment's effect on vegetation left stratigraphy exposed and kept specimens well-preserved and intact. Cuts into the western earth by railroad construction laid bare the world of deep time. Railroads provided access to previously remote locations and literally carried tons of specimens back east. The employees of the railroad were often able assistants and intelligent observers of the western geology, and they provided scientists with insight and access to the treasures of the earth. However, the railroad's role in this story was not selfless. The transcontinental railroads benefited from this relationship in that paleontologists and geologists helped in the location of the locomotive lifeblood on the treeless plains – coal.

Coal provided both the vision and the means to restore forests on the plains. It helped to establish towns, fuel industry, and drive locomotives over the formidable Rocky Mountains. Coal-fueled industrialization also fed the fires of scientific and technological advancement which galvanized the positions of scientists and engineers in a society that increasingly saw them as capable of great feats of control and prediction

over natural systems. [203] Using coal, the railroads changed how Americans experienced space and time.[204] Space shrunk and time with it. In this smaller world, it was easier to envision humanity's impact. Life was accelerated by the energies of the deep past. Paired with the increasingly detailed geologic history being written about the West through its material remains, the railroad reinforced an image of impermanence in a plastic environment.

[203] Robert V. Bruce, *The Launching of Modern American Science, 1846-1876* (Ithaca, NY: Cornell University Press, 1987), 128-130
[204] Schivelbusch, *The Railway Journey*, 33-44

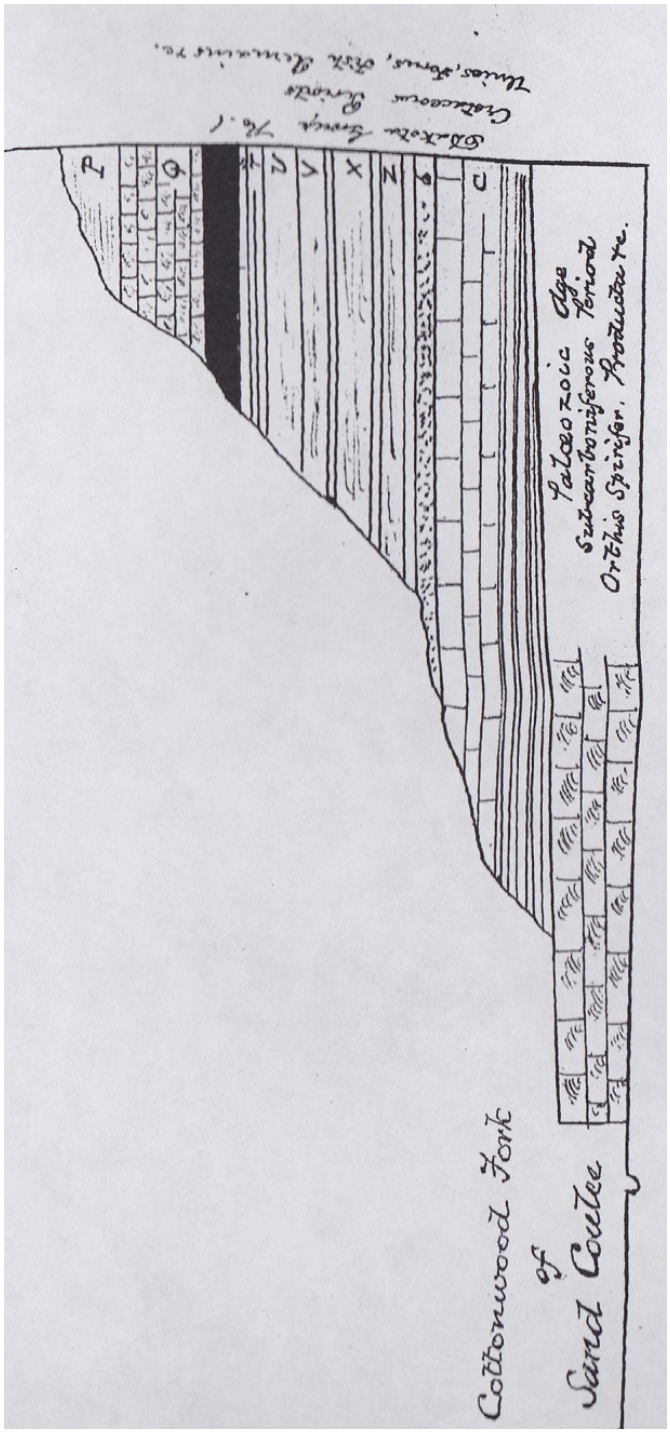


Figure 29. Sand Coulee Coal Strata with Fossils. Source: “Longitudinal Section of Strata Map—Sand Coulee, Great Falls, MT,” Colin Napier, June 15th 1886, Folder 2; 132.D.18.9.B. GN Branch Line. Great Northern Railroad Records. Minnesota Historical Society.

SCIENCE, NATIONALISM, RELIGION, AND A WATERY VISION FOR THE WEST: SEEING THE CHANGING FUTURE OF AMERICA'S ENVIRONMENT THROUGH ITS PAST

> Entire groups of animal and vegetable life have passed away and new forms have come into existence, through a series of years which no finite mind can number. To enable the mind to realize the physical condition of our planet during all these past ages is the highest end to be attained by the study of geological facts. It has been well said by an eloquent historian that he who calls the past back again into being, enjoys a bliss like that of creating.[1]
> ~Ferdinand Vandeveer Hayden, 1872

> From the Gulf there extended northwestward an immensely *wide sea*, covering the Plains region and the Rocky Mountain region as far westward as the Wahsatch Range, and dividing the continent into two continents…The disturbance which in America closed the Cretaceous period and the Mesozoic era was an arching of the earth's crust over the whole Plains and Plateau region, by which the great interior Cretaceous sea, which previously divided the continent into two continents, was abolished, and the continent became one…and its place…was partly occupied by great fresh-water lakes…[and so] Next to the Carboniferous, by far the largest coal-fields of the United States and of British America belong to the Cretaceous.[2]
> ~Joseph LeConte, 1896

Ferdinand Vandeveer Hayden recognized the power of imagination in recreating the past.[3] The process of piecing together the past from its material remains was almost god-like, an act of creation. In 1896, geologist Joseph LeConte's *Elements of Geology* painted a picture of an environment that could not have been more foreign to what had

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[1] Ferdinand Vandeveer Hayden, *Preliminary Report of the United States Geological Survey of Wyoming and Portions of Contiguous Territories*; *Being a Second Annual Report of Progress* (Washington: U.S. Government Printing Office, 1872), 106.
[2] Joseph LeConte, *Elements of Geology: A Text-Book for Colleges and for the General Reader* (New York: D. Appleton and Company, 1896), 486, 513, 514, 516.
[3] Though this is an essential element of scientific practice, especially geology and paleontology, there have been some who have feared the role of the imagination in science.: Lorraine Daston, "Fear & Loathing of the Imagination in Science," *Daedalus* (Fall 2005): 16-30.

been known of the arid character of the West. Settlers had felt the dry winds, saw their crops wither and die, and often even searched in vain for water to wet their own throats. But the growing ranks of professional geologists and paleontologist granted Americans a new vision of the West, one that used the material remains of the geologic past to show how the land had changed over time. What felt like perpetual aridity was, according to the startling new insights of science, just the latest stage in a long process of wild environmental variation. Coal had given a glimpse into the flora of the West, but the fossilized remains of fauna completed the picture of a formerly watery continent that seemed to be constantly in flux.

Scholars have long recognized that the interpretations of fossils depend to a significant degree on how a society or culture orders their world. Yet this important insight has not been addressed as it applies to the American West. To the contrary, the significance of place and the material nature of fossils have largely been ignored. The fossils found in the West were not simply curiosities or evidence for deep time or evolution. Histories of paleontology in the American West are typically stories about the major figures and discoveries. These histories are also underrepresented in terms of cultural analysis that examines how fossils were incorporated into American society. Through fossils, scientists and the public began seeing a much fuller picture of the changing West. Repeated encounters with these material remains of the deep past enabled scientists and survey authors to see time and the malleability of the West in new ways. Fossils spoke through culture as knowledge of the paleo-past spread throughout nineteenth century America. The very fact that the West was desert-like inspired the

possibility of manipulating it towards a more well-watered future. Paleobotany was wedded with vertebrate paleontology to construct complete visions of former worlds. With the flora and fauna of the past uncovered by scientists scouring the West, imaginations could travel through time and become immersed in an alien environment.[4]

This chapter explores how LeConte's vision of the Cretaceous West was constructed the western experiences of early American paleontologists, western surveyors, and field workers. As the western United States became entangled in the webs of the railroads and settlers poured into the empty spaces, there were greater and greater opportunities to search out or stumble across fossils that once littered the floor of an ancient sea or were mired in a primeval bog. The pictures of the past that were revealed by western fossils were joined to larger national and religious ideologies as Americans came to make sense of them. Fossils defied visions of a desert-West and, in time, granted hope to those who wished to overcome environmental limitations.

Fossils were relevant to how Americans saw their past and future. The visions of a changing world fostered by fossil finds embedded in coal were complemented by paleontological explorations in the West that revealed a more complete image of the past. This chapter begins with how western fossils informed nationalism, environmental perceptions, and religion in Antebellum America. Next, it turns to the United States Geological Surveys of the Territories under Ferdinand Vandeveer Hayden and centrality

[4] An interesting exception to the union of paleobotany to vertebrate paleontology was the famed paleontologist O.C. Marsh's contention that fossil plants were poor indicators of geological age. There were certainly issues with paleobotanical dating during the mid-to-late nineteenth century, but his opposition to paleobotany led him to a large scientific error. It is now recognized, as it was for many in the nineteenth century, that paleobotany provides a good chronological guide to geological strata.: Charles Schuchert and Clara Mae LeVene, *O.C. Marsh, Pioneer in Paleontology* (New Haven, CT: Yale university press, 1940), 362-363.

of the K/T boundary in these reports. The earth's history was detailed to an audience interested in exploiting the resources of the West. The imaginations of these men gave this former world life and painted scenes of the past with vibrant color. As revealed by authoritative scientists, the frontier's deep history showed its changing character. The finding and interpreting of fossils was also the province of fossil hunter field workers who ventured out to seek the past in the dirt. This profession brought another group of individuals into close contact with the geological history of the West. Some of these men would attempt to reconcile their biblical beliefs with the fossils they found. Since they were encountering these fossils in context, the fossil hunter field workers also often juxtaposed the watery past with the arid environment that they experienced with their bodies. Those who touched and pondered fossils had to square them with their worldview and the world around them.

Early American Paleontology, Mammoth Nationalism, and Interpreting the Material Remains of Watery Worlds.

American interest in fossils goes at least as far back as the Lewis and Clark Expedition discussed previously in Chapters 1 and 3. At Jefferson's request, the team had made a reconnaissance of the West and found fossilized remains that intrigued their party. The fossil finds and theories of figures such as Meriwether Lewis and William Clark, Comte de Buffon, Thomas Jefferson, Georges Cuvier, Rembrandt Peale, Albert Koch, and Edwin James have been evaluated by a number of historians. However, the paleontological work of these famous men has not been considered in light of the settlement of the American West and how the continent's watery paleo-environments

entered into discourse concerning the future of the nation. Yet, from supporting Jefferson's aspirations to providing evidence for the biblical Flood, the deep past of the continent became the basis for a number of scientific, national, and religious convictions in antebellum America.

It was not simply the mineral wealth of the West that interested Lewis and Clark. While precious metals certainly contributed to the settling of the American West, the region would not be what it is today without the more energetic and monstrous remains of ancient ecologies. Perhaps the most important finds of the Lewis and Clark Expedition were the fossils and fossil fuels embedded in the fertile earth. These were some of the first signs that water had once been abundant in the West, and they suggested that large quantities of energy might one day support western settlement in treeless regions.

The Lewis and Clark Expedition documented some of the first aquatic fossils found in the interior of North America.[5] While travelling through Gregory County, South Dakota, the party of explorers happened upon a gigantic aquatic dinosaur.[6] On this foggy September day in 1804, Lewis's remarks were brief, but Clark's description detailed the discovery:

> below the Island on the top of a ridge we found a back bone with the most of the entire laying Connected for 45 feet those bones are petrified, Some teeth & ribs also Connected… below this on a hill on the L. S. we found the

[5] George Gaylord Simpson, "The Beginnings of Vertebrate Paleontology in North America," *Proceedings of the American Philosophical Society* 86, no. 1 (1942): 168-172.; For information on the fossil discoveries that preceeded Lewis and Clark, see: George Gaylord Simpson, "The Discovery of Fossil Vertebrates in North America," *Journal of Paleontology* 17, no. 1 (1943): 26-38.

[6] Michael J. Everhart, *Oceans of Kansas: A Natural History of the Western Interior Sea* (Bloomington, IN: Indiana University Press, 2005), 14-15.

> back bone of a fish, 45 feet long tapering to the tale, ⟨Some teeth⟩ &c. those joints were Seperated and all petrefied[7]

The fossil was a *Plesiosaur*, the four-finned, long-necked model for today's Loch Ness Monster.[8] Four of the Expedition members made note of finding this fossilized Cretaceous creature in their journals. Aside from diagnostic descriptions of its length and calling it a "very large fish" or a "monstrous large fish," one Expedition member noted that they recognized the "petrified" fish's scientific significance and sent parts of the specimen back to Washington.[9] These men found this specimen near the center of the North American continent about fifteen hundred miles from either coast. Landlocked and on the central plains, they must have wondered how such an immense fish could have come to lay to rest so far from any sea.

Was this evidence of the western sea sought by Jefferson?[10] The fossil might well have suggested to Jefferson and members of the Lewis and Clark Expedition that they were in fact traversing what was once a sea and that they were possibly nearing a vast

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[7] Meriwether Lewis, William Clark, et al., September 10, 1804 entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1804-09-10.xml&_xslsrc=LCstyles.xsl.

[8] For example, in 1887 a Wyoming newspaper claimed that there was scientific evidence for the existence of a sea monster that was similar in form to the plesiosaurus.: *Bill Barlow's Budget*, Douglas, WY, March 3, 1887, page 6.

[9] Meriwether Lewis, William Clark, et al., September 10, 1804 entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1804-09-10.xml&_xslsrc=LCstyles.xsl.

[10] Lewis and Clark historian David Lavender suggested that in another case, the party's passing of Montana's Musselshell River without comment was perhaps a missed opportunity to mount evidence for an ancient inland sea. Lavender suggested that the name of the river was derived from Native Americans who saw the evidence of fossilized mollusks in the area and along its banks. The name origin that Lavender suggested is quite possible because the area is dominated by Cretaceous rocks and is well-known to fossil hunters today.; David Sievert Lavender, *The Way to the Western Sea: Lewis and Clark across the Continent* (Lincoln, NE: University of Nebraska Press, 2001), 202.

inland sea from which these remains could be traced.[11] The changes of the land could be viewed through the fossils embedded in the earth. The Expedition had come across a number of fossils of aquatic fauna from the Cretaceous, and by 1806 in Montana, the repeated exposure to these fossils likely led Clark to incorrectly assume that a rib bone he found was from a fossil fish rather than a terrestrial dinosaur.[12] He had come to see the West as a former sea, and that image shaped his imagination as he interpreted ancient remains along his route. Due to their aquatic nature, these fossils had the potential for providing hope for the Expedition tasked with finding reservoirs and veins of water in the West.

Lewis and Clark also came across the remains of a Mammoth near an Osage Village as they were proceeding up the Missouri.[13] Into the Mammoth they quickly poured other national mythologies. Paleontology was in its infancy, and what would later be understood as the deep past was infused with the hopes and dreams about America's destiny and identity. The rise of North American paleontology coincided closely with the birth of the American nation. The curious remains of unknown creatures contained within the earth kindled the fires of American imaginations and patriotism.[14] These massive

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[11] For an early source directly referencing the Cretaceous remains found by Lewis and Clark, see: Samuel George Morton, *Synopsis of the Organic Remains of the Cretaceous Group of the United States* (Philadelphia, PA: Key & Biddle Minor Street, 1834), 25.

[12] Meriwether Lewis, William Clark, et al., July 25, 1806 entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1806-07-25.xml&_xslsrc=LCstyles.xsl.

[13] Meriwether Lewis, William Clark, et al., "Fort Mandan Miscellany, Part 1: Affluents of the Missouri River" entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1804-1805.winter.part1.xml&_xslsrc=LCstyles.xsl.

[14] A similar burst in paleontological study occurred in America after the Civil War and coincided with the process of rapid settlement in the West. Like the early nineteenth century, the post-Civil War period saw paleontological finds become incorporated into American cultural imperatives and ideologies.

fossils found on American soil became fortunate scientific evidence to counter the prevailing theory of North American degeneracy advanced by the famous French naturalist George-Louis Leclerc, Comte de Buffon.

To Buffon and like-minded Europeans, the animals and men of the New World were inferior specimens, mere shadows of greater beings when compared to the Old World.[15] Buffon believed that the climatic and geologic history of North America was to blame for its deficiencies. He had interpreted the signs that the continent was once much wetter to mean that the New World was entirely *too* watered, humid, and verdant. The combinations of these factors worked to reduce the heat in the atmosphere and impregnate it with "unwholesome exhalations" emanating from decay or "putrefaction."[16] The history of the continent was at fault for these conditions. Such a rich and verdant land was an untamed and tangled wilderness due to the lack of adequately civilized men in America. Because of the "brutes" who had "neglected" their responsibility to cultivate the earth, the sun could not reach the soil and render it fertile enough to support large animals. [17] Buffon not only believed this to be the fault of the human history of the continent, but also considered this the fault of its geologic history. Thinking deeply, Buffon revealed the impact of the watery past of the New World:

> When we reflect on these very striking differences between the old and new continents, we can hardly help supposing that the latter is, in fact, more recent, and has remained buried under the ocean longer than the rest of the globe;

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[15] Georges-Louis Leclerc Comte de Buffon and J. L. Barr, *Barr's Buffon: Buffon's Natural History: Containing a Theory of the Earth, a General History of Man, of the Brute Creation, and of Vegetables, Minerals, &C. &C from the French with Notes by the Translator in Ten Volumes*, trans. J.S. Barr, X vols., vol. VII (London: Printed for the Proprietor and Sold, 1797), 27.
[16] Buffon and Barr, *Barr's Buffon*, VII, 45, 46.
[17] Buffon and Barr, *Barr's Buffon*, VII, 45-46.

> for, the enormous western mountains excepted, which seem to be monuments of the most remote antiquity, it has all the appearance of being a land newly sprung up. We find sea-shells in many places under the very first stratum of the vegetable earth, formed into masses of lime-stone, though usually less hard and compact than our free-stone.[18]

Buffon accepted the geological reality of the geographic terms Old World and New World. The North American continent only emerged recently from its oceanic origins—the fossilized sea shells found close to the surface of its soils and embedded in its soft stone made this clear. Even those species such as the Mammoth that astonished Buffon with their immense size, and therefore might be used to reject his claims, no longer existed due to the degraded nature of the continent.[19] Buffon's North America was in its youth both geologically and in terms of its civilized population, and as a result it was in a degenerate state compared to the Old World.

In the context of the American Revolution, this interpretation did not sit well with American patriots.[20] Soon after the Revolution, figures like Jefferson sought to resurrect the antiquity and superiority of North America and its inhabitants. Jefferson was well aware of Buffon's science and had even visited him while minster to France.[21] However, he heartily disagreed with Buffon's stance on American degeneracy. Consequently, a significant section of Jefferson's *Notes on the State of Virginia* was devoted to refuting the theory of degeneracy by comparing the sizes of European and North American

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[18] Buffon and Barr, *Barr's Buffon*, VII, 46.
[19] Buffon and Barr, *Barr's Buffon*, VII, 55.
[20] John C. Greene, *American Science in the Age of Jefferson* (Ames, IA: Iowa State University Press, 1984), 29-30; Paul Semonin, *American Monster: How the Nation's First Prehistoric Creature Became a Symbol of National Identity* (New York: New York University Press, 2000), 6.
[21] Greene, *American Science in the Age of Jefferson*, 28-29.

animals.[22] The verdant nature of America was not a liability to Jefferson, but rather a reason for hope for his agricultural aspirations for the nation. To be sure, some of the nation lacked sufficient cultivation, but that would come in time as it progressed westward into the garden.[23]

America's antiquity and supposed God-given destiny of domination were inextricably linked to magnificent animals such as the Mammoth. George Washington, Benjamin Franklin, and Thomas Jefferson all owned fossilized Mammoth teeth.[24] Fossilized remains convinced these men that the North American continent was home to gigantic animals, contradicting Buffon's claims of degenerate American animals. The Mammoth, or American *incognitum*, became the rallying point for rebuffing Buffon.[25] Elevating its significance was the theory that it was a carnivorous and savage beast rather than an herbivorous forager like its modern-day descendants. The beast's wild and aggressive nature came to represent the nation's aspirations for mastering the continent which would later be encoded in the popular concept of Manifest Destiny.[26]

Jefferson's imagination filled the unknown regions of the West with prehistoric animals he believed represented the greatness of America. Elephantine fossils found in famous quarries such as Big Bone Lick in Kentucky whetted Jefferson's appetite for

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[22] Thomas Jefferson, *Notes on the State of Virginia with an Appendix*, III ed. (New York: M. L. & W. A. Davis, 1801).
[23] Jefferson believed in an early variant of the theory "rain follows the plow" that will be discussed in Chapter 7.: James Rodger Fleming, *Meteorology in America, 1800-1870* (Baltimore, MD: Johns Hopkins University Press, 1999), 3-4.; James Rodger Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control* (New York: Columbia University Press, 2010), 7.
[24] Mark V. Barrow, *Nature's Ghosts: Confronting Extinction from the Age of Jefferson to the Age of Ecology* (Chicago, IL: University of Chicago Press, 2009), 17.
[25] Barrow, *Nature's Ghosts*, 17.
[26] Semonin, *American Monster*, 12-13, 38.; For an examination of the cultural impact and influence of fossil in Britain, see: Michael J. Freeman, *Victorians and the Prehistoric: Tracks to a Lost World* (New Haven, CT: Yale University Press, 2004).

further knowledge of these ancient beasts.[27] So little was known about where Lewis and Clark would embark that the possibility remained for one of the nation's experts on the region – Jefferson – to hold out hope for finding a live Mammoth roaming the garden of the world.[28]

Jefferson, like many of his contemporaries, did not accept the possibility of extinction; he rejected the idea on religious grounds and a firm belief in a conservative economy of nature.[29] Jefferson's hopes to find a living Mammoth were derived from this dismissal of extinction, as well as the western science of English anatomist William Hunter and Native American accounts that these carnivorous creatures still roamed the frontier.[30] Local extinction might be possible, but Jefferson like many of his contemporaries believed that locally extinct species were simply yet to be found in the vast unexplored expanses of the globe. In the eighteenth century, with increased exploration and expanding empires of natural science, encounters with exotic and monstrous species across the Earth encouraged many to believe that the book of nature

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[27] Adrienne Mayor, *Fossil Legends of the First Americans* (Princeton, NJ: Princeton University Press, 2005), 56.; Semonin, *American Monster*, 184-5, 195-6, 350-52; Greene, *American Science in the Age of Jefferson*, 32, 34, 289.; Keith Stewart Thomson, *The Legacy of the Mastodon: The Golden Age of Fossils in America* (New Haven, CT: Yale University Press, 2008), 15-33.; For more information on Big Bone Lick, see: Stanley Hedeen, *Big Bone Lick: The Cradle of American Paleontology* (Lexington, KY: University Press of Kentucky, 2008).

[28] Semonin, *American Monster*, 344, 348.

[29] Greene, *American Science in the Age of Jefferson*, 32.; Semonin, *American Monster*, 182, 230, 304-5.; Donald Worster, *Nature's Economy: A History of Ecological Ideas* (New York, NY: Cambridge University Press, 1994), 124.

[30] Barrow, *Nature's Ghosts*, 18-19.; Semonin, *American Monster*, 183.; Mayor, *Fossil Legends of the First Americans*, 57.; More recently, Native American historian Vine Deloria, Jr. used Jefferson's justifications and use of Native American knowledge to suggest that perhaps he was correct in assuming that Mammoths existed into modern times. See: Vine Deloria Jr., *Red Earth, White Lies: Native Americans and the Myth of Scientific Fact* (New York: Scribner, 1995), 120-1, 144-45, 155.

was simply not yet fully read.[31] Subsequent exploration into frontier regions and previously untrodden locales, and the discovery of ever more fossilized species, made it increasingly likely that species could indeed become entirely extinct.

The Mammoth, as a representative of fossilized ancestors of elephants, also became the subject of Georges Cuvier's 1796 paper that advanced concrete evidence for extinction.[32] In his full version of the study on elephants published in 1806, Cuvier added his discoveries of marine fossils that were found with and attached to mammalian remains. He deduced from these fossils that there had once been a long-lived sea that had rapidly inundated these remains—not a fleeting deluge like Noah's Flood.[33] These revolutions on the surface of the globe thereby accounted for mass extinctions.

Cuvier's work was no match for the opposing cultural currents that favored the Flood.[34] When Cuvier's *Discourse on the revolutions of the surface of the globe* was translated by Scottish geologist Robert Jameson it was renamed *Theory of the Earth,* and he altered the text to bolster the view of Cuvier's latest geologic revolution as Noah's Flood.[35] Furthermore, Cuvier's ideas on extinction posed a problem to Jefferson—as noted above, he adhered to the theory of the great chain of being, the economy of nature,

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[31] Martin J. S. Rudwick, *The Meaning of Fossils: Episodes in the History of Palaeontology* (Chicago, IL: University of Chicago Press, 1985), 89.
[32] Barrow, *Nature's Ghosts*, 19, 41.; Rudwick, *The Meaning of Fossils*, 101, 105-109.
[33] Rudwick, *The Meaning of Fossils*, 109-112, 134.
[34] For more information on the impact of Noah's Flood on geology (also known as diluvial theory or diluvialism) and the role of the Bible in early debates in geology, see: Charles Coulston Gillispie, *Genesis and Geology: A Study in the Relations of Scientific Thought, Natural Theology, and Social Opinion in Great Britain, 1790-1850* (Cambridge, MA: Harvard University Press, 1996).; Martin J. S. Rudwick, *Worlds before Adam: The Reconstruction of Geohistory in the Age of Reform* (Chicago, IL: University of Chicago Press, 2008), 73-87.
[35] Rudwick, *The Meaning of Fossils*, 132-135.

and views of biblical literalists.[36] The destruction or loss of a species would disrupt the seemingly perfect great chain of being and imply imperfection in God's handiwork.[37] To support those uncomfortable with extinction and favoring a biblical view of the history of the earth, the Mammoth remains proved a worthy specimen. Oddly enough, due to their culturally malleable nature, along with their support for extinction, fossilized remains of Mammoth's were also mustered to bolster biblical beliefs. Fossils could be resurrected and speak in a variety of ways through their human interpreters, from the extremes of enlightenment secularism to the heights of biblical literalism and anywhere in between. Fossils, like the West, were plastic and impregnated with cultural baggage. There was a definite material solidity that had to be reconciled in configuring the meaning of fossils, but they were nonetheless subject to the vaporous visions that floated on the wind currents of culture.

Charles Willson Peale's famous Philadelphia museum brought the American *incognitum* to an interested American public and ushered in today's use of the term "mammoth" to describe any large object or concept.[38] The popularity of the Mammoth was further spread by Rembrandt Peale who was tasked by his father to promote their prize.[39] For example, Rembrandt's 1803 pamphlet, *An Historical Disquisition on the Mammoth*, served to advertise for his father's museum and the scientific significance of the purportedly carnivorous specimen. Like Jefferson, Rembrandt saw the Mammoth as a carnivorous beast, but unlike Jefferson (who soon realized the error of this assumption)

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[36] For information on the great chain of being and the problem of fossils as evidence of extinction, see: Barrow, *Nature's Ghosts*, 19-26.
[37] Rudwick, *The Meaning of Fossils*, 64-65, 86.
[38] Barrow, *Nature's Ghosts*, 33, 37-38.
[39] Thomson, *The Legacy of the Mastodon*, 49.

and his father, Rembrandt believed that the beastly Mammoth was lost to extinction.[40] Rembrandt began the *Historical Disquisition* by recognizing how powerfully the malleability of the earth has captured the imagination of "the learned, and excited various speculations concerning the time, cause and manner" of the "revolutions" that have characterized the history of the earth.[41] The evidence of revolutions characterized by violent agitation was plain to see in the strata "discovered in mines or exposed cliffs."[42] Rembrandt was sure to cite and quote extensively from Cuvier to support his claims about the revolutions that have wrought changes on the globe. Some of the most striking evidence of these changes were explained by quoting Cuvier who stated:

> [i]mmense collections of shells lie buried far from any sea, and at heights inaccessible to its waves: fishes are found in veins of slate, and vegetable impressions at heights and depths equally astonishing…These traces of desolation have always acted on the human mind; the traditions of deluges, preserved among almost every people, are derived from these marine productions thus scattered over the earth.[43]

The fossilized remains of sea creatures found far from their obvious home in the ocean worked on the "human mind" and were put to use to fulfill cosmological purposes. Rembrandt understood the Mammoth as an aquatic carnivorous animal that dined primarily on "fish or flesh, and not improbably on shell fish."[44] It is probable that he deduced this in part due to the shelly marle surrounding the Mammoth bones in New York. Rembrandt believed the "immense quantity of animal remains found in the

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[40] Thomson, *The Legacy of the Mastodon*, 49-50.
[41] Rembrandt Peale, *An Historical Disquisition on the Mammoth, or, Great American Incognitum an Extinct, Immense, Carnivorous Animal, Whose Fossil Remains Have Been Found in North America* (London: E. Lawrence, 1803), 1.
[42] Peale, *An Historical Disquisition on the Mammoth*, 3.
[43] Peale, *An Historical Disquisition on the Mammoth*, 3, 4.
[44] Peale, *An Historical Disquisition on the Mammoth*, 48, 77-78.

limestone, and the perfect impressions of vegetables in slate," were evidence of the malleability inherent in the earth's history where "sudden revolutions" changed the face of the planet in succession over long periods of time.[45] He entertained the idea "that a deluge devastated the whole of that part of America [New York], because the country abounds with petrifactions of marine productions, and such as we know now are to be found only in the tropical seas."[46] Rembrandt's revolution by deluge was in tune with biblical beliefs, but he did not accord with the "fanciful chain of nature" that denied extinction.[47] Breaking the chain of nature meant that species, as well as the Earth, were malleable.

The cult of the Mammoth did not die out quickly, nor did its association with biblical theories of the earth's history. Another museum proprietor and fossil collector, the German immigrant Dr. Albert C. Koch who one historian called a "shameless showman," also had his edifice of curiosities in St. Louis, Missouri.[48] In 1841 Koch published *Description of the Missourium Theristocaulodon* in which he outlined his discovery of an ancient animal that used to roam with Mammoths.[49] Koch's work used Mammoth and Mastodon fossils to paint a paleo-environmental portrait that fused catastrophism, biblical literalism, and Native American knowledge. "Now let our imagination be brought back to the time when those huge animals inhabited the rivers mentioned," Koch enjoined his readers, using "Geological research." This was a time

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[45] Peale, *An Historical Disquisition on the Mammoth*, 67-68.
[46] Peale, *An Historical Disquisition on the Mammoth*, 74, 90-91.
[47] Peale, *An Historical Disquisition on the Mammoth*, 75.
[48] Thomson, *The Legacy of the Mastodon*, 84, 136.
[49] The Missourium Theristocaulodon was actually an incorrectly assembled Mastodon later sold to and reconstructed by the British Museum.; Thomson, *The Legacy of the Mastodon*, 84.

when the "earth presented a surface well watered and abounding with springs, streams and rivulets" and "[i]ts soil, enriched by the dew of heaven, and impregnated with the spirit of animal and vegetable life, poured forth a luxuriant growth." Koch considered it the fault of man that this state of the land no longer existed. "This period according to my impression," Koch confessed, "is the one alluded to in scripture, saying 'the ground was cursed for man's sake and its productions materially changed'."[50]

Koch imagined an Eden-like landscape where Mammoths and his *Missourium* roamed in peace and plentitude. This was changed dramatically when the land was "cursed for man's sake." Though it was "hardly possible for human comprehension to conceive" how "dreadful this change must have been," Koch believed that the cataclysm producing this revolution "was a certain Comet that came in contact with our globe." This heavenly body sank continents and created new ones while "the whole of the earth was deluged with a flood of the agitated waters, and unnumbered millions of living things, swept at once from the stage of action, and mingled in the common ruin."[51] Overtly expressed in his explanation are references to the Fall, Noah's Flood, and geologic catastrophism. Koch even went as far as comparing the *Missourium* "with the Leviathan, as Described in the 41st Chapter of the Book of Job."[52]

Koch's final claim was that he had been able to gather evidence that supported his "belief, that there was a human race existing cotemporary with those animals."[53] He

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[50] Albert C. Koch, *Description of the Missourium Theristocaulodon (Koch), or Missouri Leviathan, (Leviathan Missouriensis,) Together with Its Supposed Habits, and Indian Traditions, Also Comparisons on the Whale, Crocodile, and Missourium, with the Leviathan, as Described in the 41st Chapter of the Book of Job* 5th Edition (Dublin: C. Crookes, 1843). 4-5.
[51] Koch, *Description of the Missourium Theristocaulodon,* 5.
[52] Koch, *Description of the Missourium Theristocaulodon,* 20.
[53] Koch, *Description of the Missourium Theristocaulodon,* 25.

recognized that this theory was contrary to information "well known by all persons acquainted with geology."[54] Yet, he reasoned that this is the fault of the incomplete nature of the fossil record and that those who have come across these remains were unable or uninterested in identifying these crucial fossils. To support this claim Koch cited evidence from a diverse crowd including a farmer, a judge of the United States Court, and the archeologist, historian, and politician Caleb Atwater, that attested to the discovery of human remains alongside "fossil bones of antedeluvian animals" and deposited by the deluge.[55]

It was this particular claim that motivated eminent geologist James Dwight Dana to respond in an 1875 article titled, "On Dr. Koch's Evidence with regard to the Contemporaneity of Man and the Mastodon in Missouri" in *The American Journal of Science and Arts*. In this article Dana called upon Koch to address the existence of humans with "various extinct Quaternary Mammals."[56] In assessing Koch's virtues as a man of science, Dana stated he was "a man of enterprise" who "performed a great service to science by his collections" but he "knew almost nothing of geology" or zoology and clearly "had not been trained to scientific investigation." [57] Thus, even though he held biblical beliefs of his own, in the end Dana judged "Dr. Koch's evidence of the

[54] Koch, *Description of the Missourium Theristocaulodon*, 25.; As shall be seen in Chapter 5, the booster William E. Webb also openly rejected geological opinion on this matter in his text *Buffalo Land*.
[55] Koch, *Description of the Missourium Theristocaulodon*, 26-28.
[56] James Dwight Dana, "On Dr. Koch's Evidence with Regard to the Contemporaneity of Man and the Mastodon in Missouri," *The American Journal of Science and Arts* IX, no. 3 (1875): 335.
[57] Dana, "On Dr. Koch's Evidence with Regard to the Contemporaneity of Man and the Mastodon in Missouri," 337, 340, 342.; Dana considered Koch's use of catastrophism as evidence of his lack of scientific training and regarded Koch as a mere showman catering to his audience.

cotemporaneity of Man and the Mastodon *very doubtful*."[58] However, it is important to acknowledge that Dana's assessment came over thirty years after Koch spread his gospel of apparent pseudoscience to the public, amateurs, and men of science alike. Koch's theories were not his alone and no doubt captured the attention of the public.[59] In order for Dana to have produced scholarship that took the trouble to dismiss Koch's claims and credentials thirty years after the fact, there surely must have still been advocates aligned with Koch's vision.[60]

For many nineteenth-century Americans, the western traditions of science and natural history were put to work with the objective of revealing God's plan and verifying elements of scripture. During the late eighteenth and early nineteenth centuries, many Americans saw the nation's antiquity within the context of the biblical narrative referencing the most revolutionary and cataclysmic event to alter the globe's physical geography.[61] In the minds of many Americans the Mammoth remains found in both Siberia and embedded in New York and Ohio soil were direct evidence for the historical reality of Noah's Flood which dispersed these bones across the globe.[62]

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[58] Dana, "On Dr. Koch's Evidence with Regard to the Contemporaneity of Man and the Mastodon in Missouri," 346.
[59] Simpson, "The Beginnings of Vertebrate Paleontology in North America," 168.
[60] Even though Dana dismissed Koch's claims, they did not disappear. For example, Charles Dana Wilber called upon Koch to speak about the contemporaneity of humans and the Mastodons and stated that we need not think of the Western hemisphere as the eventual abode of humans, but rather as a region with a long lineage of human presence.: Charles Dana Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest* (Omaha, NE: Daily Republican Print, 1881) 237-238.
[61] Semonin, *American Monster*, 4, 12.
[62] Semonin, *American Monster*, 63; Thomson, *The Legacy of the Mastodon*, 28.

The biblical Deluge was made all the more probable for some because of the presence of aquatic of marine fossils far from the sea.[63] Just as this peculiar phenomenon did not escape the attention of eighteenth and nineteenth-century scholars of the natural world, it occupied the minds of men of antiquity such as Strabo, Aristotle, and Herodotus.[64] It continued to inhabit the psyches of those in the seventeenth century such as the Danish naturalist Steno who is famous for revealing what geologists today call the law of superposition in 1669.[65] Thomas Jefferson's attention was also drawn to these confounding fossil finds far from the foaming sea. However, he found little truth in the tales that they told. In his *Notes on the State of Virginia*, Jefferson expressed interest in the presence of fossil shells on mountaintops.[66] Jefferson noted that their existence has been "considered by many, both of the learned and unlearned, as a proof of an universal

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[63] Alan Cutler, *The Seashell on the Mountaintop: A Story of Science, Sainthood, and the Humble Genius Who Discovered a New History of the Earth* (New York: Dutton, 2003), 9-13.; Gillispie, *Genesis and Geology*, 42.; Rudwick, *The Meaning of Fossils*, 36-37.

[64] Adrian J. Desmond, "The Discovery of Marine Transgression and the Explanation of Fossils in Antiquity," *American Journal of Science* 275 (1975): 692-707.

[65] Steno was driven to dive into this subject through his study of shark's teeth and the enigma of fossilized "sea objects found at a distance from the sea." In the end, Steno's conclusion concerning the distribution of these remains of sea creatures was in alignment with biblical accounts of a "universal deluge" and he stated, "Nature does not oppose Scripture in determining how great that height of the sea was."; Cutler, *The Seashell on the Mountaintop*, 109-112, 145.; Rachel Laudan, *From Mineralogy to Geology: The Foundations of a Science, 1650-1830* (Chicago, IL: University of Chicago Press, 1987), 38-41, 96, 231.; Martin J. S. Rudwick, *Bursting the Limits of Time: The Reconstruction of Geohistory in the Age of Revolution* (Chicago, IL: University of Chicago Press, 2005), 97. 104-105.; Niels Stensen and John Garrett Winter, *The Prodromus of Nicolaus Steno's Dissertation Concerning a Solid Body Enclosed by Process of Nature within a Solid* (New York: The Macmillan Company, 1916), 208, 265.

[66] Jefferson also corresponded with David Rittenhouse concerning the nature of fossil shells and bones. Jefferson stated in this correspondence that in the face of alternative explanations such as the universal deluge or that they be remains of animals, he would sooner believe that "they grow or shoot as chrystals do." He did consider that they earth that is now land was once under the ocean. But Jefferson concluded that it was necessary to await until they see their process of formation in something "analogous to the known operations in nature.": Julian P. Boyd, ed. *The Papers of Thomas Jefferson* Vol. 8, 25 February to 31 October 1785 (Princeton, NJ: Princeton University Press, 1953), 565-566.; Julian P. Boyd, ed. *The Papers of Thomas Jefferson* Vol. 9, 1 November 1785 to 22 June 1786 (Princeton, NJ: Princeton University Press, 1954), 215-217.

deluge."[67] Jefferson's explorations into this mystery of the natural world led him to the conclusion that there were no satisfactory hypotheses that accounted for fossils on mountaintops and "[i]gnorance is preferable to error."[68] Others such as Buffon and Leonardo da Vinci contended that the evidence simply did not support a catastrophic deluge of the biblical sort.[69] The problem of petrified marine fauna far from the sea was yet without an answer built from consensus. But this did not stop many from finding meaning in the fossils found in America.

Fossils found in the West were even put to use to explain the origins of the Great American Desert. The geological observations and theorizing of the Long Expedition (discussed in more detail in Chapter 1) were written by Dr. Edwin James, the author, compiler, botanist, and geologist for the expedition.[70] He was a Vermont-born graduate of Middlebury College who studied botany, medicine, and geology under Amos Eaton.[71] Using Wernerian geological theory and works of geologists Henry Rowe Schoolcraft and Amos Eaton, James crafted his geological section of the expedition narrative which was

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[67] Thomas Jefferson, *Notes on the State of Virginia with an Appendix*, III ed. (New York: M. L. & W. A. Davis, 1801), 43.
[68] Jefferson, *Notes on the State of Virginia with an Appendix*, 46; Greene, *American Science in the Age of Jefferson*, 31.; Semonin, *American Monster*, 230.
[69] Cutler, *The Seashell on the Mountaintop*, 46-47.; Buffon and Barr, *Barr's Buffon*, I, 220-262.
[70] Dr. Edwin James replaced the original botanist Dr. William Baldwin and the original geologist Augustus Jessup. See: Richard G. Beidleman, "The 1820 Long Expedition," American Zoologist 26, no. 2 (1986): 308; Maxine Benson, *From Pittsburgh to the Rocky Mountains: Major Stephen Long's Expedition, 1819-1820* (Golden, CO: Fulcrum, 1988), iv-viii, xii-xiii.; William H. Goetzmann, *New Lands, New Men: America and the Second Great Age of Discovery* (New York: Penguin Books, 1987), 123.; George J. Goodman and Cheryl A. Lawson, *Retracing Major Stephen H. Long's 1820 Expedition: The Itinerary and Botany* (Norman, OK: University of Oklahoma Press, 1995), xii.; Richard George Wood, *Stephen Harriman Long, 1784-1864: Army Engineer, Explorer, Inventor, Frontier Military Series* (Glendale, CA: A.H. Clark, 1966), 115.
[71] Wood, *Stephen Harriman Long*, 91-92.; Roger L. Nichols and Patrick L. Halley, *Stephen Long and American Frontier Exploration* (Newark, NJ: University of Delaware Press, 1980), 111.

later used by Eaton in his *Geological Textbook*.[72] The particular passages that pertain to the watery past of the West arise is this section, or chapter XIX. In the subsection, "Of the great American Desert," James noted "[t]hat the great Sandy Desert has resulted from the wearing down of the mountains, both before and since the retiring of the ocean."[73] In a subsequent publication James poetically revealed how he felt adrift in this "abode of perpetual desolation." "In these boundless oceans of grass," James believed, "his sensations are not unlike those of the mariner, who beholds around him only the expanse of the sky and the waste of the waters."[74] Not only was the West once an ocean, but it retained its oceanic feel long after its waters had dried up.

The West may have been comparatively barren when James and Long explored its expanses, but through the paleo-environmental portraits suggested by fossils, geologists and explorers recognized its dramatically different oceanic past. The abundant fossils of the West indicated to these men that the desert was once an ocean. James consistently remarked on the fossilized remains of marine organisms he found entrapped in western rocks. For example, he recounted that he found "remains of marine animals and plants," and limestone containing "animal remains" deposited "during periods when great

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[72] Goetzmann, *New Lands, New Men,* 123.; Nichols and Halley, *Stephen Long and American Frontier Exploration*, 176; Carlo Rotella, "Travels in a Subjective West: The Letters of Edwin James and Major Stephen Long's Scientific Expedition of 1819-1820," *Montana: The Magazine of Western History* 41, no. 4 (1991): 33; James refered to the work of Abraham Gottlob Werner who created the Wernerian school of geological theory also known as Neptunism. James also refered its rival theory the volcanists or plutonism. Edwin James, *Account of an Expedition from Pittsburgh to the Rocky Mountains, Performed in the Years 1819 and '20, by Order of the Hon. J.C. Calhoun, Sec'y of War under the Command of Major Stephen H. Long: From the Notes of Major Long, Mr. T. Say and Other Gentlemen of the Exploring Party,* Vol. 2 (Philadelphia, PA: H.C. Carey and I. Lea, 1823), 390, 394, 404.

[73] James, *Account of an Expedition from Pittsburgh to the Rocky Mountains,* Vol. 2, 388.

[74] Edwin James, "Remarks on the Sandstone and Flœtz Trap Formations of the Western Part of the Valley of the Mississippi. By E. P. James, Attached to the Exploring Expedition Commanded by Major S. H. Long, of the United States Engineers. And by the Major Communicated to the Society, with the Permission of the Hon. J. C. Calhoun, Secretary of War," *Transactions of the American Philosophical Society* 2 (1825): 193.

tranquility prevailed in the waters of the primeval ocean."[75] The fossils found were not simply the signs of an ancient seaway or curiosities for conjecture concerning a continental ocean. They had utility in understanding the geology of the West and thereby locating useful resources. In fact, the zoologist and member of the Long Expedition, Thomas Say, was one of the first Americans to recognize the value of what would later be called biostratigraphy, which was discussed previously in Chapter 2.[76] In the inaugural volume of *The American Journal of Science*, Say emphasized that "America is rich in fossils" and "[t]hese rich repositories must finally be exposed to view, but the onward pace of improvement…the result of enterprise in the pursuit of grain."[77] One could identify strata by the fossil remains embedded within.[78] Say also was indicating that he believed that more of these marine fossils would be found through the forward march of agricultural civilization across the continent. The expedition's official report and the views of its members therefore reveal a conflicting image of the West. It was clearly a plastic place where waters once ran over the plains. But it was also a formidable desert-barrier that was at present useless for settlement. As we will see in the following

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[75] James, *Account of an Expedition from Pittsburgh to the Rocky Mountains*, Vol. 2, 391, 412.
[76] William H. Goetzmann, *Army Exploration in the American West 1803-1863* (New Haven, CT: Yale University Press, 1959), 57-58.; Nichols and Halley, *Stephen Long and American Frontier Exploration*, 176.; Like later paleontologists Cope and Marsh, Say also collected Native American skulls while in the field. See: Beidleman, "The 1820 Long Expedition," 309.; Charles Wyllys Betts, "The Yale College Expedition of 1870," *Harper's New Monthly Magazine* (October, 1871), 665.; Lawrence Bradley, "Dinosaurs and Indians: Paleontology Resource Dispossession from Sioux Lands," (PhD diss., University of Nebraska, 2010), 37, 46-47.; George Bird Grinnell, "An Old-Time Bone Hunt: An Account of the Expedition Undertaken by Prof. O.C. Marsh in 1870 to the Then Wild West," *Natural History, The Journal of the American Museum* XXIII, no. 1 (January-February, 1923): 333.; Mayor, *Fossil Legends of the First Americans*, 301.; Charles Hazelius Sternberg, *The Life of a Fossil Hunter* (New York: Henry Holt and Company, 1909), 94-95.
[77] Thomas Say, "Observations on Some Species of Zoophytes, Shells, &c, principally Fossil," Art. XII, *American Journal of Science*, I (1818): 382.
[78] For information on the use and discovery of fossils as they relate to stratigraphy internationally, see: Rudwick, *Bursting the Limits of Time*, 11-58.; Rudwick, *Worlds before Adam*, 529-555.

chapters, the remains of the ancient western environments would begin to overturn the pessimism of Zebulon Pike, Stephen Long, and Edwin James.

The above accounts indicate that fossils (especially aquatic fossils found in unexpected places, such as the tops of mountains or in the desert) could serve many interests: provide hope for explorers seeking water in the West, be the friend of the nationalist seeking to exhibit America's greatness, hearten biblical literalists searching for evidence of Noah's Flood, or aid those contemplating the origins of the arid West. The American West is littered with the remains of ancient denizens of aquatic environments due to its watery deep past, creating a landscape that was rarely read only in terms of its contemporary appearance. The fossils of the North American continent provided fuel for many ideologies and could be made to muster support for either a land of unlimited potential or a land in retrograde.

Surveying the Changing West

The nature of fossilization yielded conditions ripe for imagining landscapes as seascapes and reading the malleability of the land. One of the so-called "biases" in the fossil record is that flora and fauna of the marine variety are far more likely to be preserved than terrestrial.[79] Under water, the dead are most likely to become buried by sediments and placed under the pressure and mineralizing conditions required for fossilization. Left on land, the dead are exposed to the wear of weather and the hunger of organisms. Therefore, due to the nature of fossilization, the arid American West is an

[79] Arthur J. Boucot, "Punctuated Equilibrium Versus Community Evolution," in *The Paleobiological Revolution: Essays on the Growth of Modern Paleontology*, ed. David Sepkoski and Michael Ruse (Chicago, IL: University of Chicago Press, 2009), 442.

ideal environment for scientists and nonscientists alike to find evidence of paleo-seascapes exposed across the landscape.[80] Sparse vegetation and the unobscured evidence of erosive forces are environmental realities of the arid West. The result is that spotting fossils is relatively simple as one surveys the unobscured earth. Along with the industrialization of the nation, nature conspired to make the West the place to mine rich fossil beds that made the minds of late nineteenth and early twentieth-century geologists, paleontologists and nonscientists swim through deep time. These remains of the deep past satisfied their curiosity, contributed to their science, and fueled their imaginations as they saw the plasticity of the places where they plucked up pieces of the past. This section highlights the work of United States Geological Survey (USGS) scientists who interpreted these remains in imaginative ways.

The collection of fossils was initially often limited to locations that were near towns supplied by the railroads. This was a fact of paleontological practice in the West, because transportation and the resources of industrial society were of vital importance to these expeditions due to their size and the tons of rock that they had to transport. As mentioned in Chapter 3, along with improving access to the earth itself, the railroads provided transportation for personnel and specimens to and from previously remote regions of the West.[81] Similar to the British scientific empire that used Royal Navy networks to collect natural history specimens, the U. S. Government-subsidized railroads

[80] It is not necessarily a new idea that the fossil record was incomplete and that there were biases. For example, Charles Lyell had pointed out a bias in the fossil record that selected against finding mammalian remains.; Peter J. Bowler, *Fossils and Progress: Paleontology and the Idea of Progressive Evolution in the Nineteenth Century (*New York: Science History Publications, 1976), 71.

[81] Thomson, *The Legacy of the Mastodon*, 7, 172-173.; Jeremy Vetter, "Science Along the Railroad: Expanding Field Work in the Us Central West." *Annals of Science* 61, no. 2 (204/04/01 2004): 187-211.; Jeremy Vetter, "Field Science in the Railroad Era: The Tools of Knowledge Empire in the American West, 1869-1916," *Historia, Ciencias, Saide - Manguinhos* 15, no. 3 (July-Sept. 2008): 597-613.

enhanced military security in the West and ferried fossil hunters to these now-secure areas.[82] Hayden's 1871 expedition represented one such military-aided railroad ride based in reciprocity to scientifically explore and document natural resources in the West.[83] On June 4th, 1871, Hayden wrote Spencer Baird of the Smithsonian, "[w]e have been splendidly treated by the Army, especially Col. Reynolds at Fort Russell, and the Union Pacific railroad Co. We transported 6 car loads of freight and animals (42) and 28 men for $693. If full freight and fare had been charged the cost would have been $3500 at least."[84] The report that came out of this particular excursion by Hayden contained further evidence of the reciprocal nature of this relationship between railroads, the military, and scientists.

As the Federal Government and railroads prepared the West for rapid settlement after the Civil War, paleontologists and geologists gathered new data to reconstruct how it looked long ago. The process of preparing for the drive west was performed by

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[82] Brett M. Bennett and Joseph Morgan Hodge *Science and Empire: Knowledge and Networks of Science Across the British Empire, 1800-1970* (New York: Palgrave Macmillan, 2011).; Examples from the United States Geological Surveys of the Territories include.: Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 5.; Ferdinand Vandeveer Hayden, *Preliminary Report of the United States Geological Survey of Montana, and Portions of Adjacent Territories; Being a Fifth Annual Report of Progress for the Year 1871* (U.S. Government Printing Office, 1872), 6, 348, 366, 369, 370, 371.; Ferdinand Vandeveer Hayden, *Sixth Annual Report of the United States Geological Survey of the Territories: Embracing Portions of Montana, Idaho, Wyoming, and Utah; Being a Report of Progress of the Explorations for the Year 1872* (U.S. Government Printing Office, 1873), 9.

[83] Aubrey L. Haines, *The Yellowstone Story: A History of Our First National Park*, Rev. ed., Vol 1. (Yellowstone National Park, WY: Yellowstone Association for Natural Science; University Press of Colorado, 1996), 135-155.; Marlene Merrill, *Yellowstone and the Great West: Journals, Letters, and Images from the 1871 Hayden Expedition* (Lincoln, NE: University of Nebraska Press, 1999), 5-23.

[84] Merrill, *Yellowstone and the Great West*, 63.; Marsh's 1870 Yale College Expedition likewise received military support. His student George Bird Grinnell noted that their military support was in large part a product of Marsh's excellent politicking. "He [Marsh] had interested General P. H. Sheridan in his project," explained Grinnell, "and from him had obtained orders directed to military posts in the West to provide the party with transportation and escorts needed in passing through dangerous Indian country." These military men even assisted in collecting fossils.; Grinnell, "An Old-Time Bone Hunt," 330-332, 335.

government surveys that took place in the mid-to-late nineteenth century.[85] As discussed in Chapter 3, the scientists and explorers in the employ of the surveys frequently traveled by rail and were tasked with inventorying the resources of the West for the purpose of settlement and natural resource exploitation.[86] Through Manifest Destiny, the Mexican Cession and the Great Reconnaissance, state and federal geological surveys, the Pacific Railroad Surveys, massive amounts of data and specimens came flooding into the hands of American scientists. Survey inventories inevitably included fossils. A question inevitably arose: how to make sense of these fossils in the context of westward expansion?[87]

The most comprehensive and accessible avenue for accessing the vast amounts of knowledge Hayden's expeditions into the West uncovered were the second, fifth, and sixth United States Geological Surveys of the Territories.[88] These surveys were constructed from the material Hayden gathered on his 1871 Yellowstone expedition, smaller parties he sent out to make specialized investigations, and his accumulated knowledge and specimen-base collected during his many treks into the western field. The

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[85] Robert V. Bruce, *The Launching of Modern American Science, 1846-1876* (Ithaca, NY: Cornell University Press, 1987), 64-65, 201-204.; Paul Lucier, *Scientists & Swindlers: Consulting on Coal and Oil in America* (Baltimore, MD: The Johns Hopkins University Press, 2008), 1.

[86] The railroad permeates narratives of American exploration and paleontological science in the West. For examples, see: Richard A. Bartlett, *Great Surveys of the American West* (Norman, OK: University of Oklahoma Press, 1962).; Goetzmann, *Army Exploration*.; Goetzmann, *Exploration and Empire*.; Goetzmann, *New Lands, New Men*.; Thomson, *The Legacy of the Mastodon*.

[87] As Mott Greene stated, "North American geologists generally found the geology of the Old World as odious as its politics and fashioned American theories to solve American problems." Those theories, according to Greene, had to be forged in the field, but geologists came to the "realization that if fieldwork dominated by a single theory was dangerous, fieldwork uniformed by any theory was impossible."; Mott T. Greene, *Geology in the Nineteenth Century: Changing Views of a Changing World* (Ithaca, NY: Cornell University Press, 1982), 14, 292.

[88] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming.*; Hayden, *Preliminary Report of the United States Geological Survey of Montana,.*; Hayden, *Sixth Annual Report of the United States Geological Survey of the Territories.*

paleontological sections of these reports are of particular use for showing the visions of the plastic paleo-past being offered up to the public who might be interested in settling in the West. In the sixth report, Hayden related in his note to the Secretary of the Interior that, "[i]t is a part of the policy of the survey to invite distinguished specialists to examine some of the more obscure and difficult problems in the geology of the West."[89] Each of these reports exhibits these participants' particular approaches in describing and imagining the geologic past of the West. The visions advanced by the eminent contributors Fielding B. Meek, John Strong Newberry, Joseph Leidy, and Edward Drinker Cope are discussed below.

The material remains of watery western paleo-environments played an important role in these reports and in the ways the West would be imagined. The geological events that accompanied the transition from the Cretaceous to the Tertiary Period (what scientists today refer to as the K/T boundary) had long intrigued Hayden who sought fossils of these past times to prove his theories.[90] Today's science tells us that during the Cretaceous tectonic forces elevated the Rocky Mountains and much of the western plains. While the mountain range was being built and increased in mass, a depression temporarily formed adjacent to its base where water collected and varied in depth according to tectonic movement. After the tectonic processes had eased at the K/T boundary, the seaway retreated back to the depths of the ocean basins. In the wake of its

[89] Hayden, *Sixth Annual Report of the United States Geological Survey of the Territories*, 7-8.
[90] The geologic Period named the "Cretaceous" is derived from the Latin "creta." The "K" that represents the term "Cretaceous" comes from the German word for chalk "kreide." The transition period between the Cretaceous and the Tertiary Period is also known as the Cretaceous-Paleogene boundary and is represented by "K-Pg." This transition, which occurred around 65 million years ago, is also marked by a famous extinction event that wiped non-avian dinosaurs off of the planet. For information on Hayden's interest in this period, see: Merrill, *Yellowstone and the Great West*, 22-23.

recession, the organic remains that would later become deposits of fossils and fossil fuels remain suspended in their stratified graves. The coal is technically from the Paleocene, at the border of the Cretaceous and Tertiary Periods. Much of the coal in Montana was formed as a result of the shifting dimensions of the Cretaceous Seaway that resulted in forming isolated bogs and swamps across the landscape. These heavily vegetated, isolated bodies of water formed large coal beds soon after the Cretaceous period ended and tectonic forces isolated these regions long enough for coal formation. [91] Nevertheless, popular and academic representations of these coal regions have tended to describe them as Cretaceous. The convenient location of coal and fossils did not escape scientists surveying the western landscape in the nineteenth century.

Indeed, one of the primary reasons that the K/T boundary attracted Hayden's attention was its association with coal. At this geologic boundary he believed that he had discovered a basin of lignite coal in the West that was 60,000 square miles, which he termed the "Great Lignite."[92] Hayden mined the K/T boundary because he was interested in locating evidence of both fossils and fossil fuels to achieve his dual goals of advancing science and western settlement. In terms of exploring Yellowstone his stated objective

[91] Albert W. Bally and the Geological Society of America, *The Geology of North America: An Overview. A,[1]* (Boulder, CO., 1989), 555-573.; Albert W. Bally and the Geological Society of America, *The Geology of North America: Economic Geology, U.S. P,[2]* (Boulder, CO., 1989), 463-522, 547-590.; Albert W. Bally and the Geological Society of America, *The Geology of North America: Sedimentary Cover – North American Craton: U.S. D,[2]* (Boulder, CO., 1989), 77-82, 221-241.; Walter E. Dean and Michael A. Arthur, "Cretaceous WIS Drilling Project: An Overview," in *Stratigraphy and Paleoenvironments of the Cretaceous WIS, USA*, ed. Walter E. Dean and Michael A. Arthur (Tulsa OK: Society for Sedimentary Geology, 1998), 2.

[92] Mike Foster, *Strange Genius: The Life of Ferdinand Vandeveer Hayden* (Niwot, CO: Roberts Rinehart Publishers, 1994), 125, 184-188.; The "Great Lignite" was later named the "Laramie Formation" by Hayden's institutional rival Clarence King.

was to "strip that region of all romance" through sound science.[93] In practice he achieved just the opposite. Hayden captured the imagination of so many with his studies of the region that he helped stir romantic sentiment to create the world's first national park.[94] More importantly for this analysis, Hayden's exploration of the K/T boundary helped to put the vision of a physically and climactically plastic West into the minds of boosters and prospective settlers through his survey reports.

The introduction to the section on paleontology in the second report was written by Hayden's old friend and field-mate, Fielding B. Meek. His paleontological report explored the existence and extent of the seaway that once covered the West, the geological conundrum of the K/T boundary where the sea receded and was replaced by fresh water, and the uncertainties of geologic time. "That this change from marine to brackish-water conditions was *exactly* contemporaneous with the close of the cretaceous epoch," explained Meek,

> and the introduction of the tertiary in Europe, is not certain; nor is it necessary that this should have been the case to constitute the older rock cretaceous and the later tertiary, because of the use of these terms we have reference rather to the *order of succession* of certain great physical changes, affecting life in distantly-separated parts of the earth, than to the *exact* time of the occurrence of these changes.[95]

The relationship between European and American geologic forms and science can be seen in this comparison. Scientific interest in the Cretaceous West was not limited to the North American continent, and nor were American earth scientists simply interested in

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[93] Merrill, *Yellowstone and the Great West*, 70.
[94] For the history of Yellowstone National Park, see: Aubrey L. Haines, *The Yellowstone Story: A History of Our First National Park*. Rev. ed. 2 Vols (Yellowstone National Park, WY: Yellowstone Association for Natural Science; University Press of Colorado, 1996).
[95] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 291.

local formations and organisms.[96] The American West was providing an ideal arena to test geological theories that had thus far been constrained to the geography Europe. Understanding the malleability of the earth was increasingly an international affair.[97]

Also in the second report, geologist and Chair of geology and paleontology in the School of Mines at Columbia University, John Strong Newberry, argued that the North American climate and flora of the Cretaceous Period were a mirror of that which existed in the mid-to-late nineteenth century.[98] The plasticity of the earth soon showcased its potential for reversal, and during the very same geologic period (the Cretaceous) the climate shifted character to be tropical and wet.[99] A prospective settler or western booster searching for scientific proof of the malleability of the West could easily read into this passage that the present conditions in the West might again reverse and come to resemble a lush Eden.

Newberry also recognized that his elaborate descriptions could yield this germ of thought in the minds of men, and so he issued a half-hearted corrective. He began by

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[96] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 377.; Henry Fairfield Osborn, Helen Ann Warren, and Charles Robert Knight, *Cope: Master Naturalist; the Life and Letters of Edward Drinker Cope, with a Bibliography of His Writings Classified by Subject; a Study of the Pioneer and Foundation Periods of Vertebrate Palaeontology in America* (Princeton, NJ: Princeton University Press, 1931), 1-19.; Leonard G. Wilson, *Lyell in America: Transatlantic Geology, 1841-1853* (Baltimore, MD: Johns Hopkins University Press, 1998), 5-6.

[97] By at least 1902, the press was relaying the recognition of the international importance of America's fossils. For example, an article from Lexington, Missouri, referred to the many fossil caches found in the West and stated, "[s]cientists say they promise more in the way of clearing up mooted points of geology than the whole of Europe.": *The Lexington Intelligencer*, Lexington, Missouri, November 15, 1902.; Also, the international scope of the Cretaceous can be seen in unconventional places such as the World War I memoir *Storm of Steel* where the protagonist stated, "[a] geologist would have enjoyed the posting. The approach trenches cut through six different distinct types of rock, from coral rag to the Gravelotte marl that the firing trench had been cut into. The yellow-brown rock was full of fossils, especially of a flattish, bun-shaped sea urchin, which one could see literally thousands of along the trench walls." Ernst Jünger and Michael Hofmann, *Storm of Steel* (New York: Penguin Books, 2004), 181.

[98] For more information on John Strong Newberry, see: Charles A. White, "Biographical Memoir of John Strong Newberry, 1822-1892," *National Academy of Sciences of the United States of America Biographical Memoirs* (1902): 9.

[99] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 336.

recognizing the fact that the "pictures which geology holds up to our view of North America" during the Tertiary Period are "more attractive and interesting than could be drawn from its present aspects." The arid western landscapes paled in comparison to the beauty of the tropical past when "a warm and genial climate prevailed." The ancient West was a verdant paradise with "broad valleys covered with forests grander than any of the present day" with "rich savannah," "countless herds of animals" of gigantic proportions, and"[n]oble rivers" flowing like rich veins through the land. This had been the character of the West "[t]hrough unnumbered ages the seasons," a time when "no human eye was there to mark its beauty, nor human intellect to control and use its exuberant fertility." Humanity had not yet arrived to both appreciate nature's splendor and to govern its natural resources. "Life and beauty were everywhere," Newberry explained, "and man, the great destroyer, had not yet come; but not all was peace and harmony in this Arcadia." It was not just humanity that Newberry saw as a destructive force, but nature too was at work reducing "redundant life" to "abundant death." Newberry saw life in this past age at "war" and species contending with "the struggle for life" that left some "blotted out forever." The Tertiary West was a paradise and it was plastic, but the same forces of nature were at work in the past and present.

Newberry's corrective came at the conclusion of this elaborate description of former abundance. Time, Newberry recognized, was "infinite and incomprehensible to us." Thus the changes he outlined should not lead one to infer that "*terra firma* was less firm, or that the order of nature in which no change is recorded within the historic period, was less constant then than now." Newberry knew that hopeful minds reading his

description of the colossal changes of the West's geological past could be encouraged by the plastic world he painted. Yet time, he claimed, was not on the settler's side. "At the present rate of change," Newberry requested that his audience recognize, "– throwing out man's influence – a period infinite to us would be required to revolutionize the climate, flora, and fauna, but there is no evidence that changes were more rapid during the tertiary ages." Newberry assured his readers that while the Tertiary Period was Eden-like, there was no chance that this paleo-environment might rapidly return through natural processes. However, he did leave room for human influence over the environment, as the species tends to be a powerful "destroyer" of the natural world. Rapid climactic changes might yet be enacted on the natural world through the influence of humanity.[100]

Partial reconstructions of former environments were now possible with western fossils. Paleobotany was wedded with vertebrate paleontology to construct complete visions of former worlds. With the flora and fauna of the past uncovered by scientists scouring the West, imaginations could travel through time and become immersed in an alien environment. Vital to reconstructing paleo-environments was another renowned contributor to the survey, Joseph Leidy. He was considered by his contemporaries to be "the greatest naturalist America had ever produced" and is regarded by historians as the "father of vertebrate paleontology."[101] Leidy's contributions to these compendiums of knowledge were often carefully restrained and precise diagnostic descriptions of

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[100] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 338-339.
[101] Susan Glassman, Eugene A. Bolt, Jr., and Earle E. Spamer, "Joseph Leidy and the 'Great Inventory of Nature,'" *Proceedings of the Academy of Natural Sciences of Philadelphia* 144(1993): 1; Leonard Warren, *Joseph Leidy: The Last Man Who Knew Everything* (New Haven, CT: Yale University Press, 1998); Henry Fairfield Osborn, "Biographical Memoir of Joseph Leidy, 1823-1891," in *National Academy of Sciences of the United States of America Biographical Memoirs Volume VII* (1913).

paleontological specimens. Yet, Leidy was not always so conservative. In the fifth report he provided a little more flourish as he covered the Tertiary deposits of Wyoming by elaborating the ancient life of the region:

> The land and waters of ancient Wyoming swarmed with turtles…Lizards, also, like the iguanas and monitors, existed in the old Wyoming fauna…Serpents, too, appear to have been abundant, most of them of the constricting kind, like the South American boas of to-day…Some of the shales of Green River teem with well-preserved fishes, sometimes appearing as if whole shoals had been suddenly enshrined for the contemplation of future ages.[102]

Leidy avoided the scientific names of these creatures so that his description would grant his readers a point of contemporary comparison in order to assist their imaginations in seeing "ancient Wyoming."[103] Additionally, in 1870, he responded to an incorrect paleontological description by Edward Drinker Cope, and artistically described how one might properly imagine the specimen. "We may imagine this extraordinary creature," Leidy explained, "with its turtle-like body, paddling about, at one moment darting its head a distance of upwards of twenty feet into the depths of the sea after its fish prey, at another into the air after some feathered or other winged reptile, or perhaps when near shore, even reaching so far as to seize by the throat some biped dinosaur."[104] These

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[102] Hayden, *Preliminary Report of the United States Geological Survey of Montana*, 354-355.

[103] Like geology, paleontology is a science that often uses analogical reasoning to understand the nature of the deep past. This analogical reasoning had the potential to make familiar what should be alien. That is, it yielded a space where Leidy's audience could understand the former worlds of the West as similar to their own. This had the potential of leading one to understand the deep past in a way that the changes seen in the fossil record were simply climatological. They required no other mechanism for return than a change of climate.

[104] Jane P. Davidson, "Bonehead Mistakes: The Background in Scientific Literature and Illustrations for Edward Drinker Cope's First Restoration of Elasmosaurus Platyurus," *Proceedings of the Academy of Natural Sciences of Philadelphia* 152 (2002): 215-240.; Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 340-370.; Joseph Leidy, "Remarks on *Elasmosaurus Platyurus*," *Proceedings of the Academy of Natural Sciences of Philadelphia* 22 (1870).

imaginative journeys through geologic history illustrate moments when paleontologists like Leidy escaped the bounds of time to use the material remains of the paleo-past to actually envision an alternative reality to the one that they experienced bodily. These imaginative landscapes proffered by paleontologists provided both the key evidence of, and a way to envision, the plastic West.

Leidy's imaginative leaps were dwarfed, however, by that of the paleontologist Edward Drinker Cope.[105] According to the paleontologist and Cope's biographer Henry Fairfield Osborn, Cope "was brought up as a Special Creationist, literally accepting the first Chapter of Genesis as the true account of Creation, but from his earliest observations, at the age of eight, on the ichthyosaur there began his own reflections on the true order of nature."[106] From an early age, Cope was gifted with a fertile imagination that allowed an extinct creature known only through its fossilized remains to plant ultimately lead him to embrace paleontology and the depths of time it implied. He nevertheless held on to elements of his spiritual beliefs and saw the variations required for evolution as evidence of design.[107] His imagination added much lovely color to the pages of Hayden's early surveys. The second USGS report contained a tamer and more measured imaginative journey than those that followed:

> During the period when the cretaceous ocean extended from Eastern Kansas over the present site of the Rocky Mountains, and from the Gulf of Mexico to the Arctic Sea,

[105] For more information on Cope, see his life and letters: Persifor Frazer, "The Life and Letters of Edward Drinker Cope," *The American Geologist* XXVI, August (Minneapolis, MN: The Geological Publishing Company, 1900): 67-132.; Osborn, Warren, and Knight, *Cope: Master Naturalist*.; Jane P. Davidson, *The Bone Sharp: The Life of Edward Drinker Cope* (Philadelphia, PA: Academy of Natural Sciences of Philadelphia, 1997).
[106] Osborn, Warren, and Knight, *Cope: Master Naturalist*, 527.
[107] Mark Jaffe, *The Gilded Dinosaur: The Fossil War Between E. D. Cope and O. C. Marsh and the Rise of American Science* (New York: Crown Publishers, 2000), 152.

> it abounded in life. Among vertebrata, fishes and marine reptiles chiefly abounded, and in varied forms. Many of the reptiles were characterized by a size and strength exceeding that seen in any other period of the world's history.[108]

This ancient western seascape took up residence in his mind as soon as he began prospecting for fossils in Kansas. In a letter to his wife as he was first entering the Cretaceous fossil fields of Kansas on September 6, 1871, the ocean-like character of the plains gripped his mind: "On the way I had for the first time a view of the prairies. They are wonderful to me and look more like the ocean than anything I have seen."[109] Kansas's prairies, once cloaked by a shallow sea, still reminded Cope of the ocean.

In the fifth report, Cope's imagination practically jumps off of the page. He began this section with a mixed description of the settlement potential of the West. Here, the virtue of the deep past of the West was not simply in its capacity to show what the future could hold. Rather, Cope concluded that the future of the West would depend on using the remains of things created long before. Cope saw the region as "incompletely developed" and unable to provide "support of a very varied life, or of opportunities for access to its interior treasures, so beneficial to a high civilization." However, it was in its geologic past as an "old bed of seas and lakes, which has been so gradually elevated as to have suffered little disturbance," that the future of the region would be derived. "This," Cope prophesized, "is the great source of its wealth in nature's creations of vegetable and animal life, and from it will be drawn the wealth of its future inhabitants." The watery

[108] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 385.
[109] Osborn, Warren, and Knight, *Cope: Master Naturalist*, 160.

past of the West would yield a wondrous and wealthy future, Cope declared, "so long as peace and steam bind the natural sections of our country together."[110]

For the western traveler or explorer who may happen upon the physical remains of the past, Cope elaborated on what they would find. He described the fossil wealth that could be easily located and which testified to the presence of long-vanished seas. There were "huge oyster-like shells" lying around "like remnants of a half-finished meal of some titanic race" and that could "have served as a meal for a large party of men." There were teeth, jaws, vertebral columns, and paddles imprisoned in the rock ready to be found by "the explorer search[ing] the bottoms of the rain-washes and ravines."[111] It was not just the paleontologist who would find these fossilized remains. They were out there available to anyone, literally littering the western landscape and testifying to its mutable nature.

Responding to what Cope believed to be inevitable questions about these fossilized remains and this paleo-seascape that once blanketed the West, he guided his readers through his field experiences and a lengthy and stirring journey through deep time. Cope began with three questions: "What is the nature of these creatures thus left stranded a thousand miles from either ocean? How came they in the limestones of Kansas, and were they denizens of land or sea?" Cope admitted that "knowledge of this chapter in ancient history" was only "five years old," but what was known was that during "the period called Cretaceous…huge reptiles and fishes…swam over what are now the plains." Cope also consistently pointed to the international importance and

[110] Hayden, *Preliminary Report of the United States Geological Survey of Montana*, 318.
[111] Hayden, *Preliminary Report of the United States Geological Survey of Montana*, 319.

global scope of the Cretaceous. By describing a couple of his discoveries, he called upon the audience to join him in his experiences finding these fossils in the field. One such instance was a "pleasant recollection" where he and an Army officer happened across the fossil of a large reptile "projecting from the side of a bluff." From its disposition, Cope hypothesized, "[w]hile lying on the bottom of the Cretaceous sea, the carcass had been dragged hither and thither by the sharks and other rapacious animals, and the parts of the skeleton were displaced and gathered into a small area." At another quarry, Cope was blinded by limestone dust created by his own hammering, but through his "enthusiasm" he "endured the discomfort" and finally "a fine relic of creative genius was extricated from its ancient bed, and one that leads its genus in size and explains its structure." Scientific knowledge of the Cretaceous West was hard won, and Cope was a worthy pioneer paleontologist finding fossils that foretold the future through the past.

Painting a scene from the seascape that once supported these specimens, Cope stated, "[f]ar out on its expanse might have been seen in those ancient days, a huge, snake-like form which rose above the surface and stood erect…Then it would dive into the depths, and naught would be visible but the foam caused by the disappearing mass of life." Later, he dove even more deeply into the Cretaceous waters:

> These strange creatures [flying saurian] flapped their leathery wings over the waves, and often plunging, seized many an unsuspecting fish; or, soaring at a safe distance, viewed the sorts and combats of the more powerful saurian of the sea. At night-fall, we may imagine them trooping to the shore, and suspending themselves to the cliffs by the claw-bearing fingers of their wing-limbs…Tortoises were the boatmen of the Cretaceous waters of the eastern coast…The Cretaceous ocean of the West was no less remarkable for its fishes than for its reptiles. Sharks do not

> seem to have been so common as in the old Atlantic, but it swarmed with large predaceous forms related to the salmon and saury.

This vigorous life, however, soon met its fate, according to Cope, as the North American continent rose in elevation and isolated the interior sea from its former communication with the ocean. "Thus were the living beings imprisoned," Cope recounted, "and subjected to many new risks to life. The stronger could more readily capture the weaker, while the fishes would gradually perish through the constant freshening of the water."[112] The changing nature of the West would not favor the weak.[113]

The reader interested in knowing more about the resources and curiosities of the West would not have been disappointed. Cope painted a vivid picture of the ancient life of the Cretaceous with his prose. The past life and plasticity of the environment was revealed in his account of the Cretaceous West. Cope even suggested that the reader could physically encounter this paleo-seascape if they were to enter the survey region and explore. By beginning the section on the paleontological remains of the West with a description of the settlement potential of the region, he proposed that the deep past of the West had relevance to its future. The settlement that Cope encouraged in his introduction not only underwrote the expansion of the nation, but also contributed to the advancement of scientific knowledge.

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[112] Hayden, *Preliminary Report of the United States Geological Survey of Montana*, 319-324.
[113] Also, in 1871 while in the field with Hayden, Cope recounted finding fossils along the Union Pacific line near a coal mine and interspersed with the coal measures. In a paper read before the American Philosophical Society, he stated, "[i]t appears that the forests that intervened between the swamps of epochs, during which the coal was formed, were inhabited by these huge monsters.": Edward Drinker Cope, "On the Existence of Dinosauria in the Transition Beds of Wyoming," *Proceedings of the American Philosophical Society* 12, no. 86 (1871): 481-483.

The paleontology revealed in these post-Civil War surveys of the West illustrated the region's ever-changing character. Linked as they were to documents that promoted western settlement, they worked to undermine reports of an inhospitable and permanent desert barrier. According to the latest science, the land had a verdant history. Survey scientists contributed vital information to how the geologic history of the West was understood. Hayden had recruited authoritative scientists to contribute to his surveys, and those reading these reports would have been familiar with their names. The scientists were typically willing participants because they believed that the West was where the frontiers of science were being pressed forward along with westward expansion on the iron horse. However, they were not the only ones searching for signs of fossils in the Great American Desert. They had many helpers

Fossil Hunter Field Workers:
Sensing Signs of the West's Past for Paleontologists

Western paleontology required fieldwork. The survey scientists above were familiar with life in the field. But with the expanding settlement of western America, there were also a number of other men who settled or ventured into the West and became valuable paleontological field workers. These men were another social group that appreciated western fossils and spent time envisioning the paleo-West. The fossil hunters, as they were commonly known, were valued as workers in as the western field steadily became populated. For the time being, they had a useful set of knowledge that benefitted eastern paleontologists and granted these field workers modest remuneration. Briefly, as the region was undergoing the transition from frontier to settled space during the mid-to-

late nineteenth century, paleontologists and geologists did not have complete control over the science performed in the West. In 1909, Henry Fairfield Osborn eloquently expressed the nature of America's fossil hunting profession. "The richness of the great American fossil fields, which extend over the vast arid and semi-arid area of the West, scattered both over the great plains region and the great mountain region, has resulted in the creation of a distinctly American profession: that of fossil hunting."[114]

While scientists no doubt exercised authority over fossil hunters, they could not escape the fact that they relied on this group of skilled workers to obtain, care for, and ship the very rare specimens that their science required. The "Bone Wars" between Edward Drinker Cope and Othniel Charles Marsh created a labor market for the employment of fossil hunters which also worked to launch scientific careers. This opened up a wider audience with intimate experience with fossilized remains that also came to envision a much wetter West.[115] This section will focus on the experience of the fossil

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[114] Sternberg, *The Life of a Fossil Hunter*, xi-xii.

[115] For information on the vital nature of field work and its relationship to the creation of scientific knowledge, see: Robert E. Kohler, *Landscapes and Labscapes: Exploring the Lab-Field Border in Biology* (Chicago, IL: The University of Chicago Press, 2002).; Henrika Kuklick and Robert E. Kohler, "Introduction," *Osiris* Vol. 11, Science in the Field (1996): 1-14.; David N. Livingstone, *Putting Science in its Place: Geographies of Scientific Knowledge* (Chicago, IL: The University of Chicago Press, 2003).; David N. Livingstone and Charles W. J. Withers, *Geographies of Nineteenth-Century Science* (Chicago, IL: The University of Chicago Press, 2011).; Stuart McCook, "'It May Be Truth, but It Is Not Evidence': Paul du Chaillu and the Legitimation of Evidence in the Field Sciences," *Osiris*, 2nd Series, Vol. 11, Science in the Field (1996): 177-197.; Kristian Hvidtfelt Nielsen, Michael Harbsmeier, Christopher Jacob Ries, *Scientists and Scholars in the Field: Studies in the History of Fieldwork and Expeditions* (Bristol, CT: Aarhus University Press, 2012).; Jeremy Vetter, *Knowing Global Environments: New Historical Perspectives on the Field Sciences* (New Brunswick, NJ: Rutgers University Press, 2011).; Jeremy Vetter, "The Regional Development of Science: Knowledge, Environment, and Field Work in the U.S. Central Plains and Rocky Mountains, 1860-1920" (PhD diss., University of Pennsylvania, 2005).; Jeremy Vetter, "Field Science in the Railroad Era: The Tools of Knowledge Empire in the American West, 1869-1916," *Historia, Ciencias, Saide - Manguinhos* 15, no. 3 (July-Sept. 2008): 597-613.; Jeremy Vetter, "Introduction: Lay Participation in the History of Scientific Observation," *Science in Context* 24, no. 02 (2011): 127-141.; For a great picture of field life on a western survey, see: "Field Journal. Book No. 50. Full morocco" May-November of 1877. WA MSS S-744, Box 24. Geographical Surveys West of the 100th Meridian Papers. Yale Collection of Western Americana, Beinecke Rare Book and Manuscript Library.

hunters Charles H. Sternberg, Arthur Lakes, and William Harlow Reed who worked for these feuding paleontologists and labored in the arid West for science.[116]

One of Cope's most prolific prospectors of paleo-products was the collector Charles H. Sternberg.[117] While in the field with Cope, Sternberg experienced the exceedingly vibrant imagination of his employer. In his 1909 memoir *The Life of a Fossil Hunter*, he recounted awaking Cope from an exceptionally vivid dream:

> Then, when we went to bed, the Professor [Cope] would soon have a severe attack of nightmare. Every animal of which we had found traces during the day played with him at night, tossing him into the air, kicking him, trampling upon him…When I waked him, he would thank me cordially and lie down to another attack. Sometimes he would lose half the night in this exhausting slumber.[118]

While riding alongside Cope in the field, "He was not always in a talkative mood," Sternberg reminisced, "but when he began to speak of the wonderful animals of this earth, those of long ago and those of to-day, so absorbed did he become in his subject that

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[116] While it was not the case for all fossil fieldworkers, the men discussed below were well respected for their abilities and were professionals in their own right. Many field workers even became successful credentialed scientists after their experience in the field. Charles Sternberg started as a farmer and by the end of his career he was considered a professional fossil hunter and published a number of scientific articles. Arthur Lakes was a minster and immigrant and became a respected professor of geology in Colorado. William Harlow Reed was a railroad station agent and after his experience in the field he worked for the University of Wyoming's Museum.

[117] For details on Sternberg's life and legacy, see: Katherine L. Rogers, *The Sternberg Fossil Hunters: A Dinosaur Dynasty* (Missoula, MT: Mountain Press, 1991).; References to the work of Sternberg can be found in practically any history of paleontology that concerns the American West, for example, see: Edwin H. Colbert, *The Great Dinosaur Hunters and Their Discoveries* (New York: Dover Publications, 1984).; Jane P. Davidson, *The Bone Sharp: The Life of Edward Drinker Cope* (Philadelphia, PA: Academy of Natural Sciences of Philadelphia, 1997).; Michael J. Everhart, *Oceans of Kansas: A Natural History of the Western Interior Sea* (Bloomington, IN: Indiana University Press, 2005).; Robert West Howard, *The Dawnseekers: The First History of American Paleontology* (New York: Harcourt Brace Jovanovich, 1975).; Jaffe, *The Gilded Dinosaur*.; Url Lanham, *The Bone Hunters* (New York: Columbia University Press, 1973).; Tom Rea, *Bone Wars: The Excavation and Celebrity of Andrew Carnegie's Dinosaur* (Pittsburgh, PA: University of Pittsburgh Press, 2001); Thomson, *The Legacy of the Mastodon.*; David Rains Wallace, *The Bonehunters' Revenge: Dinosaurs, Greed, and the Greatest Scientific Feud of the Gilded Age* (Boston, MA: Houghton Mifflin, 1999).

[118] Sternberg, *The Life of a Fossil Hunter*, 75.

he talked on as if to himself, looking straight ahead and rarely turning toward me, while I listened entranced."[119] At another time, in the Badlands, Sternberg enjoyed listening to Cope as "he fell into one of his frequent absent-minded moods, picturing the land as it must have been at the time of the dinosaurs, when the shale of these black-sided canyons was mud on an ocean floor."[120] Sternberg likely learned much from his mentor about seeing the changing land through fossilized remains.

Sternberg was a deeply religious man and studied under paleontologist Benjamin Franklin Mudge. Sternberg spent a lifetime in the field and became the patriarch of a family of fossil hunters, or as he proudly proclaimed, "I have raised up a race of fossil hunters."[121] Through his life in the field and his early education, he developed an informed imagination to rival Cope's and was widely recognized as a skilled fossil hunter.[122] As a child he had developed a passion for collecting fossils. While he did "not remember when I [Sternberg] first began collecting fossils," when he was young Sternberg would ponder fossil shells he found in the Kansas limestone and think about their origins. [123] That they were remains of once living beings ran counter to his religious training.

> [T]he only theory that would account for their presence and yet sustain the belief that the world was only six thousand years old, was that the Almighty, who created the rocks, could easily, at the same time, have created the ancient plants and animals as fossils, just as they were found.[124]

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[119] Sternberg, *The Life of a Fossil Hunter*, 69.
[120] Sternberg, *The Life of a Fossil Hunter*, 88-89.
[121] Sternberg, *The Life of a Fossil Hunter*, 265.
[122] Lanham, *The Bone Hunters*, 77.; The preface to Sternberg's memoir was written by the paleontologist Henry Fairfield Osborn. In this preface, Osborn explained the skill required to be a fossil hunter and the contributions to science performed by Sternberg.: Sternberg, *The Life of a Fossil Hunter*, xi-xiii.
[123] Sternberg, *The Life of a Fossil Hunter*, 1.
[124] Sternberg, *The Life of a Fossil Hunter*, 2-3.

In time, Sternberg reconciled his religious beliefs with his fossil fascination. Like Cope, his experience with fossils encouraged him to see an alternative past for the planet. With his imaginative mind as a paleontological tool, at the age of 17 and to the dismay of his father, he decided he would "make it my business to collect facts from the crust of the earth."[125]

In *The Life of a Fossil Hunter* he narrated his exceptional life as a miner of the Cretaceous West. It was "the great object of my [Sternberg's] life – to secure from the crumbling strata of this old ocean bed the fossil remains of the fauna of the Cretaceous Times."[126] So serious did he take his life's object that when he came across the remains of a fossil that a man looking for roots to build a fire destroyed, Sternberg wrote:

> Angry at the thought that any man should commit such sacrilege, - for to me these footsteps of the Creator in the sands of time are sacred, - and bitterly disappointed, since I knew that I should very likely never again come upon such huge specimens of the reptilian life of that age, I walked into camp blinded by hot tears…"[127]

It was surely a crime that these "sacred" relics would be destroyed for the sake of firewood. But Sternberg was not unaware of the trials and tribulations of frontier life. Indeed, Sternberg considered himself a farmer at the start of his fossil hunting forays.[128]

Early in his tale, Sternberg revealed how he envisioned the former marine environment that he inhabited. Thinking of his native land of Kansas during the

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[125] Sternberg, *The Life of a Fossil Hunter*, 17.
[126] Sternberg, *The Life of a Fossil Hunter*, 43.
[127] Sternberg, *The Life of a Fossil Hunter*, 139.
[128] In response to an 1875 Smithsonian Institution circular, Sternberg listed his occupation as "Farmer & Collector in Natural History & Geology." He informed the Smithsonian that he had "A small collection of insects & fossil leaves." "Answers to Circulars, Safford – Swiggert." Smithsonian Institution Archives. SIARU007002 Box 64 Folder 8.

Cretaceous Period, Sternberg credited Charles Darwin with supplying the tools to take this imaginative journey.

> How often in imagination I have rolled back the years and pictured Kansas, now raised two thousand feet above sea-level, as a group of islands scattered about in a semi-tropical sea! There are no frosts and few insect pests to mar the foliage of the great forests that grow along its shores, and the ripe leaves fall gently into the sand, to be covered up by the incoming tide and to form impressions and counterparts of themselves as perfect as if a Divine hand had stamped them in yielding wax.

Sternberg invited his reader to [g]o back with me…and see the treeless plains of to-day covered with forests." Only God, according to Sternberg was there to appreciate the "luscious fruit" of these forests. "[B]ut the glorious picture is only for him who gathers the remains of these forests, and by the power of his imagination puts life into them; for it is some five million years, according to the great Dana of my childhood days, since the trees of this Kansas forest lifted their mighty trunks to the sun." His imagination took him to this wondrously forested past in spite of the landscape that surrounded him.

> "How fleet is a glance of the mind!" Instead of an arid, treeless plain, covered with short grass, a great semi-tropical ocean lies at our feet. Everywhere along the shores and estuaries are great forests of magnolia, birch, sassafras, and fig, while a vast expanse of blue water stretches southward.

This paradisiacal land, however, was not without danger. Sternberg's tale of this past also had a host of monstrous characters [Figures 30 and 31].

> Watch that ripple! It is caused by a shoal of mackerel scurrying in toward shallow water, in a mighty column five feet deep. They are flying for their lives, for they have seen behind them their most terrible enemy, a monster fish with a muzzle like a bulldog's, and huge fangs three inches long

> projecting from its mouth. Two rows of horrid teeth, one above and one below, complete its armature. The great jaws, fourteen inches long and four deep, move on a fulcrum, and when they have dropped to seize a multitude of these little fish, they close with a vise-like power. The crushed and mangled remains pass down a cavernous throat to appease a voracious appetite.

As quickly as it flashed through his mind, this ancient scene was gone and he was once again "working with pick and shovel in the burning sun." The creatures Sternberg spent his life extracting from the Earth were "never dead" to him since his "imagination breathes life into "the valley of dry bones," and not only do the living forms of the animals stand before me, but the countries which they inhabited rise for me through the mists of the ages."[129] These visions of a watery Kansas remained powerful for Sternberg, even though his primary suffering in the field could be attributed to the "lack of good drinking water than from all the other ills combined."[130] Fossils set his imagination free to explore alternative landscapes even while he was suffering under the oppressive reality of his western quarry [Figure 32].

Sternberg was not alone in the West in large part due to two rival paleontologists who made fossil hunting a semi-profitable enterprise. Sternberg had become close friends with famous scientists such as Edward Drinker Cope and Leo Lesquereux, and was entrenched in the "Bone Wars." This conflict was a fossil feud between Cope and Othniel Charles Marsh in which they sent rival teams of fossil hunters throughout the West and berated each other in public forums for personal, paleontological, and political reasons.[131]

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[129] Sternberg, *The Life of a Fossil Hunter*, 16-17, 37-38, 48-49, 54, 59-60, 204.
[130] Sternberg, *The Life of a Fossil Hunter*, 41.
[131] Goetzmann, *Exploration and Empire*, 495.; Howard, *The Dawnseekers*, 226-270.; Rogers, *The Sternberg Fossil Hunters.*; Sternberg, *The Life of a Fossil Hunter*, 52-53, 65-66.; Thomson, *The Legacy of*

Sternberg participated in their fossil feud as a soldier in the field fighting to find fossils for Cope up until 1884 when he switched camps and marched for Marsh until 1895.[132] In his 1909 memoir, Sternberg stated that in the midst of this ill-fated quarrel he was ever-cautious. When coming across a particularly plentiful bone cache: "I would not leave, however, without my load of fossils, as I feared that during my absence my rivals would come upon this Eldorado and clean it out."[133] For fossil hunter foot soldiers on the frontline of this feud, it was not merely scientific priority that fueled their fanaticism for the remains of the ancient West. If fossil hunting was your profession, a bed of fossils was the source of your meager paycheck, a modest payment for facing the hardships of the arid western field in the service of science.

Sadly, the celebrity and expert scientific status of Cope and Marsh also enabled them to bring shame to the science of paleontology. Yet, the "Bone Wars," as they were later called, also brought a fair amount of press to the science of paleontology and encouraged Americans to think about what fossils said about the American West.[134] By employing a number of field workers, Cope and Marsh made it possible for these men to experience the landscape in a different way as a result of their discoveries. These workers nevertheless worked under the harsh climactic extremes of the West and often in desert-like environments since fossils were most easily found in denuded landscapes. The environmental disposition of fossil resources often affected the social nature of field life

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the Mastodon, 133-134, 266-270; Information concerning the feud between Cope and Marsh is present in virtually every history of paleontology that concerns the United States. For additional information about the Cope and Marsh feud, see: Jaffe, *The Gilded Dinosaur*.; Lanham, *The Bone Hunters*.; Elizabeth Noble Shor, *The Fossil Feud between E. D. Cope and O. C. Marsh* (Hicksville, NY: Exposition Press, 1974); Wallace, *The Bonehunters'*.

[132] Thomson, *The Legacy of the Mastodon*, 169; Sternberg, *The Life of a Fossil Hunter*, 129, 230.

[133] Sternberg, *The Life of a Fossil Hunter*, 46-47.

[134] Jaffe, *The Gilded Dinosaur*, 319-334, 342.; Wallace, *The Bonehunters'*, 215-20, 226-254.

during the "Bone Wars." Sternberg noted that while there was definite secrecy required by Cope, the rival camps were occasionally at peace around scarce vital resources like water.[135] Peace could certainly exist amongst rival soldiers who likely recognized their unfortunate status as invisible technicians working long hours in a punishing environment.[136] For example, Cope's Henry Fairfield Osborn and Marsh's William Harlow Reed worked with another one of Marsh's minions, Arthur Lakes. In Osborn's 1897 field notebook, he stated, "Prof. Arthur Lakes…has mapped + located all quarries + will aid us next spring."[137]

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[135] Sternberg, *The Life of a Fossil Hunter*, 34, 142.

[136] Steven Shapin, "The Invisible Technician," *American Scientist*, 77(6) 1989: 554-563.; Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago, IL: University of Chicago Press, 1994), 355-407.; Historian of paleontology Lukas Rieppel disagrees with the application of Shapin's term to paleontological specimen collectors. He notes, "[w]hereas the latter [invisible technicians] were responsible for designing and executing an experiment as well as reporting on its result, specimen collectors were not treated as assistants of collaborators by late 19th century paleontologists in the United States." However, I contend that these men in the western field possessed scientific knowledge and skill and were trusted by scientists to find and obtain priceless specimens and report back detailed information concerning environmental context. Just like in the examples provided by Shapin, they were not always invisible, but they were often absent from the scientific papers published by credentialed paleontologists. Perhaps it is best to consider them as similar to the scientific collaboration of "subordinate laborers" constructing tide tables in England, in the work of historian of science Michael Reidy. Or better yet, because Shapin and Reidy's examples come from the European historical stage and are contextually specific, that there existed a scalable spectrum of scientific participation in the American context that ranged from simple laborer to scientist. What I would like to emphasize here, however, is that working in the field for credentialed paleontologists placed these men as skilled subordinates who possessed a significant amount of power over the production of scientific knowledge credited to their employers. Out of this, they likely had a shared sense of identity. Furthermore, as the examples from Europe illustrate, this is not the only time and place in which this occurred.; (Michael S. Reidy, *Tides of History: Ocean Science and Her Majesty's Navy* (Chicago, IL: The University of Chicago Press, 2008), 198-235.; Lukas Benjamin Rieppel, "Dinosaurs: Assembling an Icon of Science" (PhD diss., Boston, MA: Harvard University, 2012), 179.); For another use of this term in relation to paleontology in the laboratory rather than the field, see: Caitlin Donahue Wylie, "Invisible Technicians: A Sociology of Work, Workers, and Specimens in Paleontology Laboratories," (PhD diss., Cambridge, England: University of Cambridge, 2013).

[137] Henry Fairfield Osborn, "Field Notes: Excursions of 1897" In *Archival Field Notebooks of Paleontological Expeditions*: American Museum of Natural History Paleontology Division. http://research.amnh.org/paleontology/notebooks/osborn-1897/00.html.; Wallace, *The Bonehunters'*, 200-201.

Arthur Lakes was an Englishman, teacher, artist, and minister educated at Oxford who migrated to the U.S. around 1868.[138] While he was not ministering to miners, Lakes became very interested in collecting the fossils around Golden, Colorado, where he was teaching writing at the liberal arts college Jarvis Hall – later incorporated into the Colorado School of Mines, where the library is now named after Lakes.[139] Lakes sent word of some of his impressive specimens to Marsh, who delayed in committing his attention and funds to Lake's discoveries. Prompting another skirmish in the tragic war between Marsh and Cope, Lakes also sent bones to Cope. Marsh, sensing Cope's advantage, took up arms and mustered his money to make Lakes a member of his network of collectors.[140]

Lakes was a wonderful writer who was also well-versed in the sciences of geology, stratigraphy and morphology. Demonstrating these skills are the eloquently composed and rich field journals from Colorado in 1877-78 and Wyoming in 1879-80, which detail field seasons he spent collecting for Marsh. In these journals are moments of tension born out from the fossil feud. On August 8, 1877, for example, Lakes received a telegram from Marsh "desiring Prof M[udge] or myself to go at once to Canon City to secure a fossil saurian lately discovered there from the hands of Professor Cope who was

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[138] Katherine K. Simmons, Beth Lakes, and Arthur Honda, *The Legacy of Arthur Lakes* (Morrison, CO: Friends of Dinosaur Ridge, 2009).

[139] Thomson, *The Legacy of the Mastodon*, 280.; Arthur Lakes, Michael F. Kohl, and John Stanton McIntosh, *Discovering Dinosaurs in the Old West: The Field Journals of Arthur Lakes* (Washington, DC: Smithsonian Institution Press, 1997), 3-4.

[140] Thomson, *The Legacy of the Mastodon*, 281-283.; Overriding decades of free access to specimens collected through interpersonal connections and networks of collectors, wealthy scientists Cope and Marsh created a market by buying specimens and hiring collectors. This so angered Joseph Leidy that he essentially left the western paleontological scene.; Ronald Rainger, "The Rise and Decline of a Science: Vertebrate Paleontology at Philadelphia's Academy of Natural Sciences, 1820-1900," *Proceedings of the American Philosophical Society* 136, no. 1 (Mar., 1992), 30.; William Berryman Scott, *Some Memories of a Palaeontologist* (Princeton, NJ: Princeton University Press, 1939), 59.

trying to get it."[141] Hayden's former field companion, Mudge, was Marsh's trustworthy trooper that took on the duty of attempting to convince the fossil hunter to defect from Cope's camp.[142]

In 1879, when Marsh dispatched Lakes to Como Station along the Union Pacific Railroad, he worked with William Harlow Reed to toil in a number of rich quarries situated around the railroad station. Another element of the railroad's link to the advancing science of paleontology was the men it provided for service to science. For example, William Harlow Reed was the railroad worker turned fossil hunter *par excellence*.[143] Born in Hartford, Connecticut, Reed was thirsty for adventure and went West to make a living off the expanding rail network. Reed worked shoveling snow for the railroad, hunting for the railroad work parties, fighting Indians equipped with knowledge of Native American languages, scouting for the U.S. Army as a civilian, and after the 1874 death of his wife in childbirth, working with the Union Pacific Railroad as a station agent at Carbon Station in Wyoming.[144] As the name suggests, Carbon Station was significant for its wealth in another type of fossilized remains – coal. In 1877, Reed was transferred eleven miles down the track to Como Station, Wyoming. Here he found his first major fossil bounty while returning after a successful hunt.[145] Reed soon wrote

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[141] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 31.
[142] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 169.
[143] William Harlow Reed is mentioned in virtually every history of paleontology. For examples, see: Url Lanham, *The Bone Hunters*.; Howard, *The Dawnseekers.*; Colbert, *The Great Dinosaur Hunters*.; Wallace, *The Bonehunters'*.; Jaffe, *The Gilded Dinosaur*.; Rea, *Bone Wars.*; Thomson, *The Legacy of the Mastodon.*
[144] Brent Breithaupt, "Biography of William Harlow Reed: The Story of a Frontier Fossil Collector," *Earth Sciences History* 9, no. 1 (1990): 6-7.
[145] Breithaupt, "Biography of William Harlow Reed…", 7.

the famous Marsh about the find, beginning a career that would ultimately make him a renowned fossil hunter and contributor to the paleontological community.[146]

During Lakes tenancy at this location with Reed, Marsh made a brief field visit where he identified a number of specimens his hunters had unearthed. Marsh regaled the party with stories of his adventures bone hunting near Fort Bridger, where he had led a group of Yale students and made subsequent expeditions to uncover treasures of the earth.[147] Cope also made an unexpected appearance at Como Station.[148] Lake's journal account of his visit on August 2, 1879, is decidedly positive. "With Cope at breakfast," Lakes recorded, "and had a pleasant chat with him about England. He entertained his party by singing comic songs with a refrain at the end like the howl of a coyote…After supper chatted with Professor Cope about geological matters."[149] In an August 11, 1879, letter to Williston, Lakes calls Cope "the Monstrum horrendum," but follows that up with, "I must say that what I saw of him I liked very much his manner is so affable & his [character?] very agreeable. I only wish I could feel sure he had a sounder reputation for honesty."[150] Lakes wanted to like Cope, but was prevented by Cope's part in the less than scrupulous tactics employed in the Bone Wars. Lakes also assured Marsh that secrecy was "strictly attended to" and that his "likeness" was "on the walls of our cabin where it

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[146] Breithaupt, "Biography of William Harlow Reed…", 6-12; Jeremy Vetter, "Cowboys, Scientists, and Fossils: The Field Site and Local Collaboration in the American West," *Isis* 99, no. 2 (2008): 278.
[147] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 104-107, 185.
[148] For a history of this location, see: John H. Ostrom and John Stanton McIntosh, *Marsh's Dinosaurs: The Collections from Como Bluff* (New Haven, CT: Yale University Press, 1966).
[149] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 130-131.
[150] Letter to Samuel Williston from Arthur Lakes; August 11, 1879: Yale Peabody Museum of Natural History, O. C. Marsh Correspondence," MS 343, Box 20, Folder 804, "The Correspondence of O.C. Marsh - Digital," http://peabody.yale.edu/collections/vertebrate-paleontology/correspondence-o-c-marsh.

can look down on us as our 'presiding genius.'"[151] Lakes was also sure to praise his friend Reed and speak to his fossil prospecting proficiency. "Reed," Lakes pointed out, "is an example of the fact that all education is not confined to those who have gone through college but much is learnt by keen observation."[152]

Fossil knowledge was not limited to those two feuding fanatics Cope and Marsh, but it was also created in the field as these men touched relics of the paleo-past. Lakes was an able and educated fossil hunter. He was continually reading material in camp in order to further his knowledge of science. In his journals he mentions reading *Vestiges of the Natural History of Creation* by Robert Chambers, Charles Darwin's "voyage of a naturalist," and returned to his journals to add content from Cope's reports that pertained to his fossil finds.[153] In his letters to Marsh he often reassured the professor that he was competent and learning a lot in the field.[154] In 1877, Lakes wrote to Marsh to bolster his confidence in his field work: "I have had ten years experience in geological maters + in collecting + handling fossils so am not a novice at the kind of work altho not before this summer have I had my attention called to vertebrate remains + so perhaps at first was a little inexperienced though Prof. Mudge + my [three?] years work I think that is

[151] November 5, 15, 1877; Arthur Lakes Letters and Sketches to O.C. Marsh from Morrison CO. 1877-1879; Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).
[152] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 107.
[153] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 70-76, 103, 113, 119, 122, 129.
[154] This tendency to reassure Marsh and inform him of Lakes' intellectual progress can be found throughout his letters to Marsh. See: Letters from Arthur Lakes to O.C. Marsh, 1876-1880: Yale Peabody Museum of Natural History, O. C. Marsh Correspondence," MS 343, Box 20, Folder 799-809, "The Correspondence of O.C. Marsh - Digital," http://peabody.yale.edu/collections/vertebrate-paleontology/correspondence-o-c-marsh.; Arthur Lakes Letters and Sketches to O.C. Marsh from Morrison CO. 1877-1879; Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).

sufficiently remedied to warrant your confidence in my [careful?] + knowledge."[155] Lakes had knowledge, credibility, and skill that he had earned in the field. One of the most crucial elements of a fossil hunter's job was to get specimens from the West to the East intact. Packing fossils was therefore a particularly important talent, given the rough-handling of railroad transportation in the late nineteenth century.

Lakes worked hard under Marsh's very particular packing instructions to ensure his "men work very carefully under my supervision + every precaution is now taken to get out arrange + pack bones with the utmost care."[156] However, regardless of his skill and attention in packing the paleontological specimens, Lakes encountered some difficulties. On November 28, 1877 he remarked to Marsh, "I fear the freight charges must be very great + that the contents are often in a much broken up condition."[157] Freight charges were still a constant problem even though there were some cooperative contracts worked out between paleontologists and railroad companies.[158] It was also

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[155] October, 11, 1877; Arthur Lakes Letters and Sketches to O.C. Marsh from Morrison CO. 1877-1879; Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).

[156] October, 11, 1877; Arthur Lakes Letters and Sketches to O.C. Marsh from Morrison CO. 1877-1879; Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT); For a great example of Marsh's particular and abundant directions to collectors, see his 1883 correspondence with M.P. Felch: Letters from M.P. Felch to O.C. Marsh, 1883: Yale Peabody Museum of Natural History, O. C. Marsh Correspondence," MS 343, Box 20, Folder 437-441, "The Correspondence of O.C. Marsh - Digital," http://peabody.yale.edu/collections/vertebrate-paleontology/correspondence-o-c-marsh.; M.P. Felch to O.C. Marsh, 1883, "Marsh-Felch: Correspondence Letters," Garden Park Fossil Area, Bureau of Land Management Royal Gorge Field Office, Canon City, CO. http://www.handsontheland.org/garden-park/letters.html.; See also: Schuchert and LeVene, *O.C. Marsh, Pioneer in Paleontology*, 172-173.; Charles Schuchert, the Assistant Curator of the Department of Paleontology at the Smithsonian Institution created a guide for fossil collection.: Charles Schuchert, *Directions for Collecting and Preparing Fossils*, Part K of the Bulletin of the United States National Museum, no. 39 (Washington: Government Printing Office, 1895).

[157] November 28, 1877; Arthur Lakes Letters and Sketches to O.C. Marsh from Morrison CO. 1877-1879; Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).

[158] Grinnell, "An Old-Time Bone Hunt," 330.; Marsh noted in his 1870 pocket notebook that he had obtained Kansas railroad passes.; Othniel Charles Marsh, Pocket Notebook 1, 1870, Yale Peabody Museum

inevitable that no matter how well they packed the specimens, damage could occur en route. Nonetheless, Lakes and his companions would make creative use of the railroad lines. While prospecting along the railroad, he and his fellow bone prospectors would use hand cars to ride the rails to their quarries.[159]

When Lakes was not tediously packing fossils or out ministering to his flocks of isolated westerners, he was flexing more than just his muscles in the field digging up dinosaurs and pumping the hand car to and from his quarries.[160] He also put his imagination to work in envisioning the paleo-past of the western field. Perhaps informed by his knowledge of the plasticity of the landscape he was traversing, ocean metaphors are sprinkled throughout his journals as he describes the countryside. In Lakes' journals a "high Cretaceous hogback…rises like a mighty ocean wave," "low wave like ridges of chalk…[are] like the waves of the sea," "upturned sedimentary rocks rising like angry waves wave upon wave," and "an ancient lake now transformed into a beautiful prairie meadow [is] transversed by long wave like ridges."[161] Seascapes had a grip on his mind as he journeyed through the dry stretches of Colorado.

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of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).; Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 15; Thomson, *The Legacy of the Mastodon*, 173.; Vetter, "Science Along the Railroad," 205-206; For an exchange between O.C. Marsh and Chester Dawes of the Chicago, Burlington & Quincy Railroad Company regarding reduced fares, see: Letter to Charles Dawes from O. C. Marsh; December 3, 5, 8, 22, 1898: Yale Peabody Museum of Natural History, O. C. Marsh Correspondence," MS 343, Box 8, Folder 342, "The Correspondence of O.C. Marsh - Digital,"http://peabody.yale.edu/collections/vertebrate-paleontology/correspondence-o-c-marsh.; Spencer Baird and the Smithsonian Institution also received favorable treatment from the railroads. For example, Baird received free freight from the Central Pacific Railroad.: Letter from Spencer Baird to J. C. Stubbs Esq. General Freight Agent of the Central Pacific Railroad Company, September 9, 1878, Smithsonian Institution Archives. RU53, Microfilm Vol. 23, Reel 22.

[159] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 98, 104, 108, 115.

[160] For examples of his ministering while in the field, see: Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 23, 25, 37, 55, 80.

[161] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 10, 25, 31, 47.

The paleo-seascapes he encountered also played a part in his journaling. At the commencement of his field experience in Colorado in 1877, Lakes was whisked away from the arid landscape and imagined:

> The wavy and irregular character of the bedding and both of which indicate the deposition of the rock through the medium of violent water either that of torrents bringing down coarse pebbles into an inland salt lake lapping the mountains or estuary of the sea or possibly a shore line of angry waves beating against the foot of the same Rockies at the time when they could hardly be called mountains at all being only just raised above the surface.[162]

At times, Lakes' imagination would even bring him into coexistence with the creatures he found fossilized in the field. While seeking shelter from the rain, he imagined himself and his partner as "modern saurians awaiting the coming storm."[163]

Fossil hunters who labored as field workers for paleontologists experienced the ancient world of the West as they touched its remains. The "Bone Wars" made their lives secretive but also remunerative. Due to the scientific demand for fossils and the necessity for fossil hunters to assist in western collection, it was not simply scientists who were inspired to use their imagination and travel into the past with fossils as their guide. These skilled amateurs felt the extreme climate of the arid West while they were using their minds to envision changes in the land. From the rocks, these men worked out evidence of a malleable environment that had once supported an abundance of life. Yet, while they often sought to emulate the knowledge of their benefactors, these men were not empty

[162] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 10.
[163] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 108.

vessels and often made sense of these changes through the lens of their wider worldview.[164]

Paleontological Field Work in the Arid West and the Bible

Expedition members who participated in the paleontological reconnaissance of the West in the mid-to-late nineteenth century carried with them religiously fueled convictions about the future of the American nation. In this section, the published journals of two figures from famous expeditions serve to show that visions of the paleo-West were closely tied to one's worldview. Hayden's former teacher and mentor George Allen and the farmer-judge-educator James Polk Sams wrote about their experiences with field life in the arid West, the character of the western environment as it related to settlement, and the geologic history of the region that they experienced through its material remains. The ancient West was seen through the cultural lenses brought into the field by these men.

The surviving journals from the Hayden's 1871 Yellowstone expedition suggest how men of science recreated the ancient West through its fossilized past. Hayden's former natural history and geology teacher, George Allen, accompanied the start of the expedition and wrote a detailed journal regarding his duties and perceptions. Allen was Hayden's first landlord and in many ways served as a father-figure for the young student. He was a devout Congregationalist and hymn-writer who nevertheless made room for

[164] For an examination of two other skilled fossil hunters and the hurdles of scientific authority, see: Ronald Rainger, "Collectors and Entrepreneurs: Hatcher, Wortman, and the Structure of American Vertebrate Paleontology Circa 1900," *Earth Sciences History* 9, no. 1 (1990).

new scientific knowledge and geological theories.[165] His religious fervor would result in one of the most troubling aspects of field life for Allen – the lax or absent observance of the Sabbath by the members of the expedition.[166] Along with his religious zeal and geologic knowledge, Allen carried with him a hatred for Native Americans and a weak constitution. As the field excursion wore on, Allen's journals clearly reveal that he was not up to the physically demanding life of the field scientist, and as a result, he did not complete the survey's circuit.[167] As an important educator and mentor to Hayden, the views contained within his journal were likely either shared or at the very least seriously considered by his student.

As he was recruiting Allen for the expedition, Hayden expressed concern regarding Allen's age and his ability to withstand the hardships of life in the field.[168] Nevertheless, Allen joined the party, and as he gazed out of the window of a passenger car on the Union Pacific Railroad on his way to the field, he witnessed the spread of what he would characterize as civilization into the frontier West.[169] As a geologist, he saw the land through a geologic lens and noted the stratigraphic record he read in the landscape from his seat on the train. In Allen's opinion, "[t]he least skilled in Geology, in passing over hastily in the cars as we did could not fail to understand it."[170] The plastic nature of the West was plainly written in the rocks.

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[165] Merrill, *Yellowstone and the Great West*, 24.
[166] Merrill, *Yellowstone and the Great West*, 43,87, 213-214.
[167] James G. Cassidy, *Ferdinand V. Hayden: Entrepreneur of Science* (Lincoln, NE: University of Nebraska Press, 2000), 36.; Merrill, *Yellowstone and the Great West*, 24-25.
[168] Merrill, *Yellowstone and the Great West*, 27-29.
[169] Merrill, *Yellowstone and the Great West*, 39.
[170] Merrill, *Yellowstone and the Great West*, 46.

Allen's geologic imagination persisted throughout his journeys through the West. The most florid examples of his imaginative journeys into the deep past come from his visions of the Cretaceous West. They are of special note due to their juxtaposition to his descriptions of the aridity of the landscapes that were taking their physical toll on his body. In a sense they were geologic mirages. After a long train ride viewing the geology of the West from his passenger car, Allen took a moment to document the nature of the landscape. In this entry he noted the sterile character of the landscape, but then praised its potential fertility. Allen began by describing the Laramie plains and their future settlement "dotted with ranches and herds of cattle." The land that lay west of these plains, however, was "exceedingly desolate" with very little rain fall. Except for a few streams that supported "narrow strips of green vegetation," it was essentially an "arid desert." But Allen believed not all hope was to be abandoned. Calling upon folk knowledge he concluded:

> It is said, however, that the soil in this great Desert, consisting mainly of clays of various shades, contains all the essential elements of plant life and that only water is needed to make the entire surface bloom and blossom like the rose. But great meteorological changes must take place before that can be.

Very soon after this passage in his journal he indicated the dramatic changes that have already taken place upon these lands. Using the marine "fossils entombed" in the West as his fuel for time-travel, he noted:

> A portion of these surface beds over which we have passed were deposited when as yet the ocean prevailed, its saline waters penetrating all these valleys and washing the shores of the higher lands which, here and there, existed as islands in a shallow sea.

This ocean existed in the geologically "recent" past, but after its recession "great changes have since taken place, involving uplifts, foldings, volcanic eruptions, denudation and erosion on a vast scale, together with changes in climate and in life once and again." The West had undergone incredible changes in the past, and according to Allen it could do so in the near future in a manner favorable to agricultural settlement.[171]

The proximity of these divergent images of an arid landscape and a well-watered lake region is suggestive of the biblical language sandwiched between these descriptions. Allen referred to the area as many had in the past, as the "Great American Desert." However, he quickly suggested that it was likely that this environment was in fact not static and permanent. The passage was also inflected with biblical imagery of the restoration of an Edenic garden. In a manner consistent with how many Americans expressed the garden potential of the West, Allen chose to allude to the biblical passage Isaiah 35:1 which stated, "And the desert shall rejoice and blossom as the rose." He was viewing this landscape as both a geologist and a Christian and thereby saw the landscape's geologic plasticity as evidence of the potential for the land to yield the promises of the progress of western settlement and the restoration of the West from desert to garden. The following day he wrote a short entry that focused primarily on how terribly he suffered from the heat. Amidst all of that aridity and heat, the next day his mind drifted into a long, beautiful, peregrination around the wet geological history of the region. Allen was "constantly trying to carry" his mind through time in order to visit the time when "a broad shallow sea" covered the West. Facilitated by "entombed" fossil

[171] Merrill, *Yellowstone and the Great West*, 48-49.

remains, he imagined "beautiful oceanic fauna" that lived their lives in the watery West. Envisioning the changes in the land through his geological training, Allen saw the continent "elevated…from beneath the ocean waves and permanently delivered from the dominion of old Neptune," leaving behind "vast lakes, or continental fresh water seas" occupied by "Sea Gods" and "Nymphs and the Naiads." The land was "clothed with the verdure of forest and meadow" and teemed with "terrestrial life, more abundant and varied than at present exist." This was, according to Allen, "indisputably…the history of this portion of our country…a history written in the rocks themselves." Allen also believed this history was confirmed by the fossils "entombed within the strata and thus wonderfully preserved – tables engraved by the finger of the Creator, himself, whether upon the tree trunk or leaf, upon scale, shell or bone, a fidelity in form and a perfection of finish is everywhere manifested, far surpassing the utmost skill of man in the work of imitation." It was left to the "geologist and paleontologist to decipher these long buried records – hieroglyphical and unintelligible to the masses, but full of unerring truth and meaning to the initiated."[172]

Concurrently, Allen was physically experiencing a hot, sterile, and arid environment, but nonetheless admitting to the potential for rapid environmental change to favor settlement based in agriculture. Allen also made direct reference to God or "the Creator" as the divine source of the fossilized life he encountered "entombed" in the earth. The proximity of these passages suggests that Allen's geological training helped him to see the landscape as more malleable, while his religious background supported the prospect of the land being reclaimed from the desert and "blossom[ing] like the rose."

[172] Merrill, *Yellowstone and the Great West*, 68-69.

His belief was not necessarily derived from a condensed geological timescale, but rather it radiated from his faith in Providence.

However, just as farmers who followed reports that the arid West could be made to bloom, dreaming of plasticity and climatological changes would do Allen no good. By July of 1870, he was feeling the weight every one of his nearly sixty years and the physical demands of the western field. Suffering from headaches and constipation that he blamed on the exposure to extremes of heat and cold, he stated, "[t]he fact is I am too old and infirm for such a mode of life, and it was folly in me to undertake it." "I trust," he dramatically continued, "for the sake of the anxious and waiting ones at home, that I may live through it…For myself, if it were the Lord's will, permanent release would be sweet to me. 'Thy will be done.'"[173] By July 6th it was decided that he would not be going on into Yellowstone, and by the 11th he had separated company from the rest of the party. In a letter to Spencer Baird of the Smithsonian, Hayden confided, "Prof. A[llen]. gave out. He is too old for this kind of work."[174]

In his 40s, the younger James Polk Sams was better able to cope with the rigors of field life and kept up with his scientific company. Like Allen, he infused his worldview with the West's geologic history. In 1895, Sams was then a Board of Regents member and he went on an expedition advanced by the fossil hunter and paleontologist Samuel W. Williston. Like Sternberg, Williston studied under Mudge in Kansas and fell into paleontology while assisting Mudge in field collecting for Marsh.[175] Thus he too entered

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[173] Merrill, *Yellowstone and the Great West*, 95.
[174] Merrill, *Yellowstone and the Great West*, 115.
[175] Richard Swann Lull, "Samuel Wendell Williston 1852-1918," *National Academy of Sciences of the United States of America Biographical Memoirs* XVIII(1919): 116.; For a biography of Williston, see:

into the "Bone Wars" through Mudge's association with Marsh and soon rose through the ranks to become Marsh's marshal in charge of western collecting parties.[176] His dreams of being a scientist were quickly if temporarily dashed by Marsh's oppressive policies which denied his students and technicians any credit for their discoveries.[177] After he had earned his M.D. from Yale in 1880, he began a teaching career there until he was offered a job in Kansas in 1890 where he had done his first field work with Mudge.[178] Williston desired to have the skull of a *Triceratops* in the Kansas University museum, resulting in the Kansas Expedition of 1895 to Wyoming. Sams kept a detailed expedition journal that survives today and provides vignettes of the daily life of fossil field workers. Sams' journal is particularly insightful because he was not a scientist-in-training, but rather an active observer of and participant in the life of a fossil hunter. According to the editors of his published journal, Sams was "middle-aged like Williston, a Kansas farmer, former probate judge…pious, humorous, teetotaling, curious and kind."[179] His personality and worldview were clearly reflected in his journals.

Sams clearly saw the land through the lens of a desert-West that could nonetheless be transformed. Pondering the auspicious start to his journey into the field,

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Elizabeth Noble Shor, *Fossils and Flies; the Life of a Compleat Scientist Samuel Wendell Williston (1851-1918)* (Norman, OK: University of Oklahoma Press, 1971).; In 1918, Williston spoke kindly of his mentor while detailing the successes and progress of the Kansas Academy of Science. For futher information on Mudge and on Williston's perspective on science, see: Samuel W. Williston, "The Progress of Science since the Foundation of the Kansas Academy of Science," *Transactions of the Kansas Academy of Science (1903-)* 29 (1918): 53-61.

[176] Sternberg, *The Life of a Fossil Hunter*, 111.; Williston, like Arthur Lakes were able to rise up through the fossil hunter to credentialed paleontologist hierarchy which suggests that the lines between amateur and scientist were permeable.

[177] Lull, "Samuel Wendell Williston 1852-1918," 117; Barnum Brown, James Polk Sams, *A Triceratops Hunt in Pioneer Wyoming : The Journals of Barnum Brown & J.P. Sams: The University of Kansas Expedition of 1895* ed. Michael F. Kohl, Larry D. Martin, and Paul Brinkman (Glendo, WY: High Plains Press, 2004), 20-21.

[178] Lull, "Samuel Wendell Williston 1852-1918," 117-118.

[179] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 15.

he honored the Civil War and stated, "The great war has been fought, the slaves are free and the desert that was is blooming in fertile fields, threaded with railroads and busy with the activities of life."[180] But his favorable vision of the future of these lands was tempered by its harsh, arid reality: "We are entering the Great American Desert…One of my old sweet girls lives here. Well! Well! Jeanine. You live in a pretty tough country… Abandoned farms have grown up to weeds and the crop prospect is slim."[181] Sams briefly observed some fertility in places like Greely, Colorado, but as he headed north towards Cheyenne, Wyoming, he stated, "Leaving these fertile fields we are soon upon the arid plains again."[182] His description of Cheyenne was less than positive: "Cheyenne, the capital of Wyoming, is a city of ten thousand people in the desert; no trees, no gardens, no nothing, but a set of cutthroats standing around waiting to beat some one."[183] Sams touched on the necessity of irrigation in the parched West in his journal when he spoke of Wheatland, Wyoming. "This is a small oasis in the desert," he explained, "just now being boomed by eastern capitalists; three irrigation ditches eight, eleven and thirty five miles in length supply the little valley with moisture."[184] Even taking a bath was a struggle in the western field.[185] At the camp that served as the expedition's home-base during the excavation of their object of desire, the *Triceratops*, Sams was equally unimpressed with the landscape. "What a lonely still spot," Sams observed, "few stunted cotton wood trees, but no sign of civilization…I find the remains of an old corral and the chimney of a

[180] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 48.
[181] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 49.
[182] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 53.
[183] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 53.
[184] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 55.
[185] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 77-78.

shack…The chimney still remains as a monument to the memory of some mans folly for having tried to live in this desert."[186] Sams could not help but be dismayed by the tyranny of aridity in the West.

Still, while Sams was no paleontologist, his more scientific colleagues helped him to see the land in new ways. On June 27, 1895, Sams noted:

> We find a monster fossil this morning…In life this animal stood about fifty-five or sixty feet long and twenty feet high and was an herb-eating sea animal of the lizard family. How did he ever get into this arid region? There are other evidences that at some time this country was covered with water. Geologists tell us at three different times, perhaps, as Job says it was when the morning stars sang together, or when the Earth was without form and void.[187]

The fossils revealed a mutable West, though Sams interpreted this vision through the Bible's creation story. On July 6th he set out to prospect in a basin "and from the appearance of turtles and clam shells in the rocks this must have been a large inland lake; but water is scarce enough now."[188] The fact that he continually juxtaposed the watery environmental image he constructed from the fossils with the actual physical arid landscape suggests that Sams was struggling to make sense of the transitory terrain he was traversing.

Even while attending church in Lusk, Wyoming, Sams pondered the landscape's ephemeral character. Sams opened his observance with Luke 21-23: "Heaven and Earth shall pass away: but my Word shall not pass away." Science, he believed, was limited in its ability to fully comprehend these changes.

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[186] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 86.
[187] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 76.
[188] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 85.

> [A]s I think of the fossilized forests or these now almost treeless plains, and of the many species of animals, large and small that have appeared and disappeared and later of the red men who inhabited these parts, the traces of which is only left on the rocks, landmarks and their graves; and when I think that with all our learning and research we can only gather a few pebbles along the shore of the vast eternity of the knowledge and power of a God Who is able to make and perpetuate so vast a universe with all its functions entering into the most minute detail of so much so that not even our small spasms can fall without his knowledge, I am filled with wonder and awe.[189]

He had absorbed the knowledge that he gathered from his experience in the field touching and being taught about the remains of the past and assimilated it into his worldview. Human understanding was limited, while the mind of God was beyond comprehension. To make sense of the changes written in the rocks, Sams called upon his religious beliefs and embraced the inability of the human intellect to fully grasp geologic history.

Sams was a religious man who found solace in reading his Bible, and he repeatedly wrote of his regret at not being able to attend church in the field and the absence of "Christian civilization."[190] He did his best to reconcile the artifacts and science he encountered in the field with his religious beliefs. It was not only in church where these worlds were juxtaposed, but also in the events of daily life in the western field. For example, he stated, "I open my Bible and read the Nineteenth Psalm and the one following and well I must go to work with hammer and chisel trimming our collection for shipping."[191] Sams' attempt to achieve a balance between these two worlds was also evident in a paper he read before the Seneca Literary Society upon his return to

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[189] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 99.
[190] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 59-60, 64, 65, 68, 78, 81, 85-86.
[191] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 65.

Kansas. In this paper, Sams indicated that the science of paleontology served the science of geology and that "nothing yet has been definitively ascertained by the research of mineralogy or paleontology about the age of our globe." Geology could, however, inform humanity about the changes that had taken place on the globe. "Science," Sams noted, "has been greatly aided in tracing the extent, duration and history of extinct inland seas of both salt and fresh water, by the fossilized remains of marine animals, reptiles and fish."[192]

His religious leanings, however, came to dominate the conclusion of his remarks. Sams nevertheless blended paleontological knowledge and the objectives of science with those of religion. He proposed a progressive evolutionary process guided by God and explained the limits of science in reading "the finger marks of God in the stratification of the rocks and in the fossiliferous deposits of the earth." For Sams, "'the ways of God are past finding out.'" [193] Yet, he used science to support his religious position. Sams saw Darwin's theories as a "religion," suggesting that they were incommensurable with Christianity because they defied the signs of progress plainly visible in the fossil record. Combining biblical faith in progress, the unique status of humanity as the pinnacle of God's creation, technofaith represented by the railroad, and a basic scientific understanding of environmental paleo-plasticity, Sams' mind contained all of the essential elements for seeing that "the desert that was is blooming in fertile fields, threaded with railroads and busy with the activities of life."

[192] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 126.
[193] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 127-128.

Experience with fossils and the geologic history of the West was not a dispassionate and diagnostic affair. Scientists and amateurs alike sought not only to understand the specimens in a scientific sense, but also to embrace fossils in such a way as to place them within their wider conception of the world. Due to the enormous pictures painted by fossils concerning the nature of space and time, it is unsurprising that larger cosmologies would play an active role in how they were understood. It was therefore not only the past, but the future that could be read from fossils. Because these men came in direct contact with fossils in the American West during a time of rapid national expansion, technological faith, and a great desire to overturn the Great American Desert, their interpretation of the geologic history of the region was inevitably inflected with these ideologies.

Conclusion

The ancient character of the West was uncovered through the discovery of fossils by early explorers, survey scientists, fossil hunters. Their finds could be put to use for a variety of purposes ranging from a degenerate continent to a future of flourishing garden. What these visions inspired by fossils had in common was that they all recognized how these remains revealed a radically changing landscape. Pondering these objects, they were confronted with the compelling material evidence that the western landscape had once been radically different. The marine fossils spoke too clearly to be ignored, yet a fuller realization of their significance would take time. Inevitably, the fossil hunters turned to their familiar world views to make sense of these earth-shaking artifacts. As railroads helped open the region, ever more Americans came into contact with these

relics and their persuasive powers grew apace. Visions of a very different and much wetter past of the arid West were not limited to the credentialed scientists and experts who were supposed to suppress their cultural biases and be true to rational observation. Experts and amateurs alike emerged from similar cultural contexts. Often both scientists and the public viewed the utility of their knowledge of the paleo-past and the transformative capacity of human intervention in the natural world. Fantastic fossil finds began to feed the public's appetite for the curiosities of science and the natural history of North America. The entangled web of Christianity, technofaith, scientific authority, industrialization, fossils, and coal shaped how Americans understood and settled of the West.

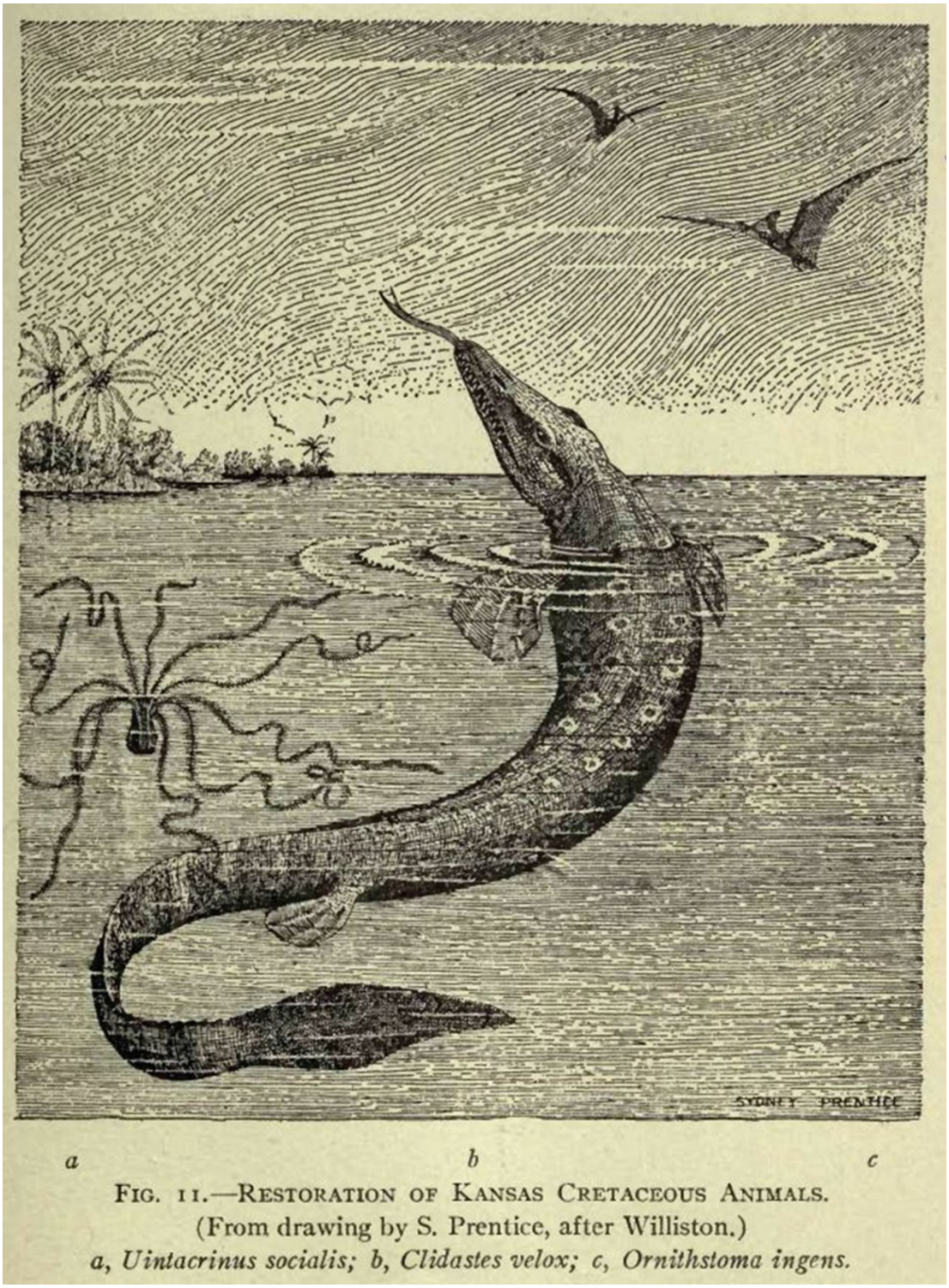


FIG. 11.—RESTORATION OF KANSAS CRETACEOUS ANIMALS.
(From drawing by S. Prentice, after Williston.)
a, Uintacrinus socialis; b, Clidastes velox; c, Ornithstoma ingens.

Figure 30. Cretaceous Restoration from Sternberg's Memoir. Source: Charles H. Sternberg, *The Life of a Fossil Hunter* (New York: Henry Holt and Company, 1909), 56.

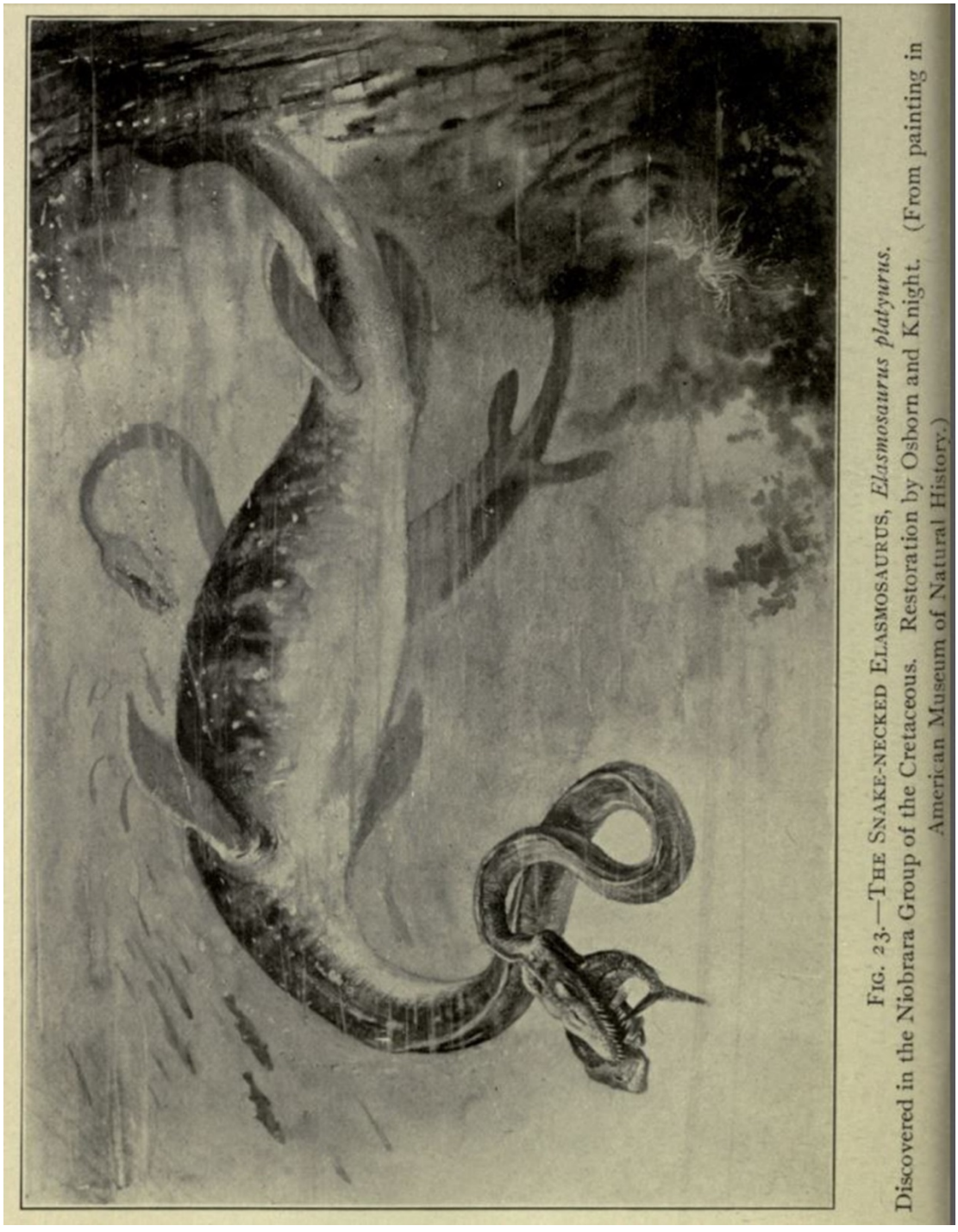


FIG. 23.—THE SNAKE-NECKED ELASMOSAURUS, *Elasmosaurus platyurus*. Discovered in the Niobrara Group of the Cretaceous. Restoration by Osborn and Knight. (From painting in American Museum of Natural History.)

Figure 31. Cretaceous Dinosaur from Sternberg's Memoir. Source: Charles H. Sternberg, *The Life of a Fossil Hunter* (New York: Henry Holt and Company, 1909), 123.

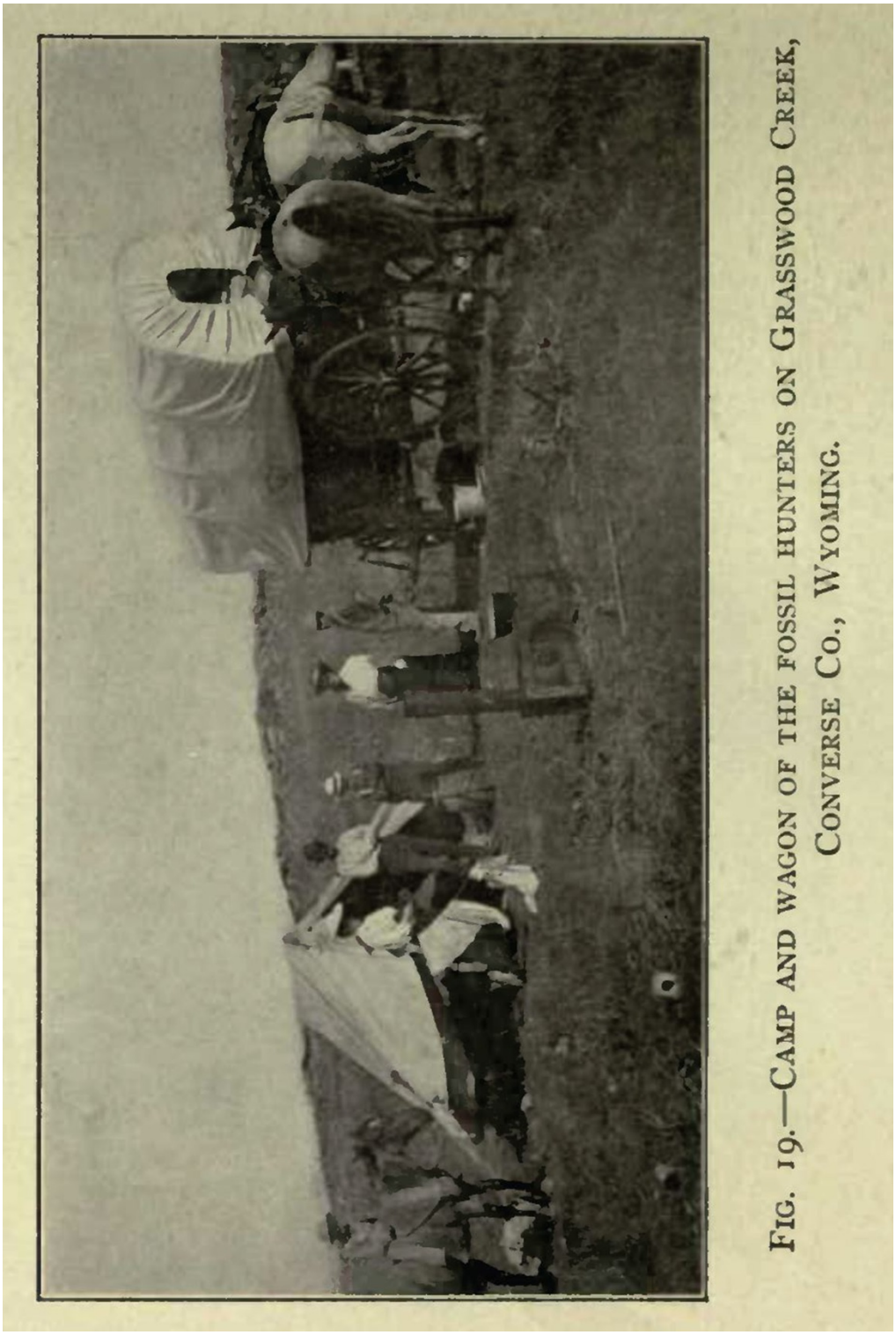


FIG. 19.—CAMP AND WAGON OF THE FOSSIL HUNTERS ON GRASSWOOD CREEK, CONVERSE CO., WYOMING.

Figure 32. Sternberg Camp Life. Source: Charles H. Sternberg, *The Life of a Fossil Hunter* (New York: Henry Holt and Company, 1909), 109.

OTHER AMERICANS EXPERIENCE THE PLASTIC WEST THROUGH FOSSILS: NATIVE AMERICANS, WESTERNERS, AND VERNACULAR PALEONTOLOGY

> The bow of this vessel exhibits the form of a huge serpent, black and scaly, rising out of the water from under the boat, his head as high as the deck, darted forward, his mouth open, vomiting smoke, and apparently carrying the boat on his back. From under the boat, at its stern, issues a stream of foaming water, dashing violently along. All the machinery is hid…The boat is ascending the rapid stream at the rate of 3 miles an hour. Neither wind or human hands are seen to help her; and, to the eye of ignorance, the illusion is complete, that a monster of the deep carries her on his back, smoking with fatigue, and lashing the waves with violent exertion.[1]
> ~ *Niles' Weekly Register*, 1819

Stephen Long's steamboat the "Western Engineer" was designed with a purpose beyond its ability to convey its cargo and passengers up the Missouri. According to one critic, it was "calculated to attract and to awe the savage."[2] Steam technology would prove useful in frightening the Native American's along the Long Expedition's route. One of the first thrusts of industrial society into the West was through the use of the steamboat. Unlike the railroad that followed and forced its way across the West, the steamboat was limited to navigable rivers. Long, the engineer-explorer, emphatically suggested to President Monroe the utility of steamboats for western exploration. The boat, aptly named the "Western Engineer," was designed by Long and constructed in Pennsylvania with a significantly reduced draft in order to navigate shallow western

[1] "Expedition to the Upper Missouri," *Niles' Weekly Register* No. 22, Vol. IV (July 24, 1819), 368.
[2] "Expedition to the Upper Missouri," 368.

rivers and actually made it the farthest of any steamboat on the Missouri River.[3] Long soon learned, however, that steamboats were not suitable for transportation on these western rivers. The "Western Engineer" had trouble fighting the Missouri's current and was prone to breaking down.[4]

Regardless of its poor performance, the steamboat used by the Long Expedition was a fascinating machine that represented the frightening force of industrial society to the western tribes. It was equipped with numerous guns and an armored wheelhouse, and flew a flag that sported the contrary images of a peace pipe, a sword, and what seemed to be a white scientist shaking hands with a Native American man.[5] Expedition member Titian Ramsay Peale, the artist-explorer-naturalist and son of the famed Charles Willson Peale referenced below, painted the "Western Engineer."[6] From this image, we can see one of the most peculiar aspects of this vessel referred to as "Long's Dragon," its serpent-styled bow [Figure 33].[7]

About a decade after the Expedition, the historian Samuel Perkins likewise described the "Western Engineer" and its effect on the Native Americans. The steamboat, according to Perkins, "was calculated to make a deep impression on the natives." To the

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[3] Richard G. Beidleman, "The 1820 Long Expedition," *American Zoologist* 26, no. 2 (1986): 308.; William H. Goetzmann, *Army Exploration in the American West 1803-1863* (New Haven, CT: Yale University Press, 1959), 41.; Roger L. Nichols and Patrick L. Halley, *Stephen Long and American Frontier Exploration* (Newark, NJ: University of Delaware Press, 1980), 66-67.

[4] Carlo Rotella, "Travels in a Subjective West: The Letters of Edwin James and Major Stephen Long's Scientific Expedition of 1819-1820," *Montana: The Magazine of Western History* 41, no. 4 (1991): 23.; Beidleman, "The 1820 Long Expedition," 307.; Goetzmann, *Army Exploration*, 41.; Nichols and Halley, *Stephen Long and American Frontier Exploration*, 99-100.

[5] Beidleman, "The 1820 Long Expedition," 308.; "Expedition to the Upper Missouri," 368.; Nichols and Halley, *Stephen Long and American Frontier Exploration*, 80-81.

[6] Maxine Benson, *From Pittsburgh to the Rocky Mountains: Major Stephen Long's Expedition, 1819-1820* (Golden, CO: Fulcrum, 1988).; Kenneth Haltman, "Private Impressions and Public Views: Titian Ramsay Peale's Sketchbooks from the Long Expedition, 1819–1820," *Yale University Art Gallery Bulletin* (1989).

[7] Richard H. Dillon, "Stephen Long's Great American Desert," *Proceedings of the American Philosophical Society* 111, no. 2 (1967): 94.

Native Americans along the bank of the Missouri, it must have seemed an unstoppable water monster running against the current breathing smoke as a result of its exertions. "By an occasional discharge of a heavy gun," he explained, "the wilderness, for miles around, appeared to echo with the bellowing of the animal." Its effect on the "wondering savages" must have been "powerful." The historian hypothesized, "[i]n their view, the great evil spirit had arisen from the deep, and was come to punish their transgressions." Consequently, "[t]hey endeavored to appease his anger, by paying homage to his power, in their accustomed manner of worship."[8]

But why would a large serpent bellowing smoke necessarily frighten Native Americans? Was this a case of Euro-Americans transposing their own legends and monsters upon another culture? Or was there something of substance to this belief that the reporter and historian may or may not have understood? Surprisingly, this vessel may have tapped into the fossil-fed cosmology of some western Native Americans. The marine fossils of the American West were not only noticed by Euro-American explorers. Native Americans also looked askance at these ancient remains of gigantic creatures and considered how they came to rest in the earth. Native American fossil finds may have provided evidence for the existence of gigantic serpents like "Long's Dragon," and therefore reason to fear its wrath.

Native Americans and westerners experienced the malleable West in its environmental context. These nonscientists confronted fossils where they lived and were forced to juxtapose and reconcile what they felt with their bodies with what they were

[8] Samuel Perkins, *Historical Sketches of the United States, From the Peace of 1815 to 1830* (New York: S. Converse, 1830). 171-172.

inspired to imagine as a result of these remains. Scientific collaboration with locals in the field provided access to fossil diggings and directed men of science or fossil hunters to fossil locales. Some westerns even communicated with scientists through the mail and would send specimens to institutions of learning in the East. Knowledge of fossils and former environments was spread through the strata of society and in the process was culturally-infused and naturalized. The late nineteenth century saw a growing public interest in fossils that fed off of these finds. It is not only the importance of amateurs to the practice of science that is crucial to recognize, but specifically the impact of touching and thinking about the fossil materials that scientists coveted.

This chapter begins with how Native Americans incorporated fossils into their cosmology, seeing them as evidence of a changing world and as powerful sacred resources. American scientists recognized the fact that these native westerners were familiar with fossils and sought their knowledge for the purpose of advancing western science. While the scientist's worldview was different from their Native guides, both saw in the fossils the past and the future environmental changes of the West and their power as natural resources. The chapter then turns to other westerners who made their way into this region and while making the place their home many uncovered fossils that they collected and shared with scientists. The chapter ends with a discussion of an exceptional westerner by the name of James Cook whose life encompassed the rapidly changing West, its clash of cultures, and interest in its fossil past.

Fear, Guides, and Native American Awareness of the Malleable West

During the last half of the nineteenth century, many Euro-American fossil hunters harbored severe prejudice of Native Americans in the West and were at times hampered in the ability to collect due to belligerent confrontations and general paranoia.[9] The West was a fearful place for many scientists seeking fossils. Tensions were high as settlers flocked into Native American lands and the United States military imposed order upon peoples increasingly seen as impediments to progress.[10] Yet, not all Native American

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[9] For example, see the following published accounts and correspondence: Marlene Merrill, *Yellowstone and the Great West: Journals, Letters, and Images from the 1871 Hayden Expedition* (Lincoln, NE: University of Nebraska Press, 1999), 15, 39, 45, 51, 59, 65-66, 72, 75, 78, 142.; Charles Wyllys Betts, "The Yale College Expedition of 1870," *Harper's New Monthly Magazine* (October, 1871): 663-668.; Many years later another of his students George Bird Grinnell published an account of this expedition and likewise referenced their fears of Native Americans and the military support granted to the party.; George Bird Grinnell, "An Old-Time Bone Hunt: An Account of the Expedition Undertaken by Prof. O.C. Marsh in 1870 to the Then Wild West," *Natural History, The Journal of the American Museum* XXIII, no. 1 (1923): 330-333.; William C. Wyckoff, "A Perilous Fossil Hunt," in *The Indian Miscellany; Containing Papers on the History, Antiquities, Arts, Languages, Religions, Traditions and Superstitions of the American Aborigines; with Descriptions of Their Domestic Life, Manners, Customs, Traits, Amusements and Exploits; Travels and Adventures in the Indian Country; Incidents of Warfare; Missionary Relations, Etc.*, ed. W.W. Beach (Albany, NY: J. Munsell, 1877), 259-266.; Charles Hazelius Sternberg, *The Life of a Fossil Hunter* (New York: Henry Holt and Company, 1909), 37, 47-48, 91-92, 98, 120, 124-125, 222-225.; Letter from Hank Clifford to O.C. Marsh, May 2, 1876; Yale Peabody Museum of Natural History, O. C. Marsh Correspondence," MS 343, Box 7, Folder 263, "The Correspondence of O.C. Marsh - Digital," http://peabody.yale.edu/collections/vertebrate-paleontology/correspondence-o-c-marsh.; Letter from Ferdinand Vandeveer Hayden to Spencer Baird, October 13, 1859, Smithsonian Institution Archives. SIARU007002 Box 24 Folder 22. "Hayden, Ferdinand Vandeveer, 1858-1860."; But there are also signs of cooperation and comedic encounters such as those of Cope and Mudge whose both have stories of their false teeth fascinating Native Americans in the field.: Sternberg, *The Life of a Fossil Hunter*, 66-68.; Arthur Lakes, Michael F. Kohl, and John Stanton McIntosh, *Discovering Dinosaurs in the Old West: The Field Journals of Arthur Lakes* (Washington, DC: Smithsonian Institution Press, 1997), 24-25, 167.; By the close of the nineteenth century, these fears began to dissipate in these field journals and accounts of field life. For example, see: Barnum Brown and James Polk Sams, *A Triceratops Hunt in Pioneer Wyoming: The Journals of Barnum Brown & J.P. Sams: The University of Kansas Expedition of 1895* ed. Michael F. Kohl, Larry D. Martin, and Paul Brinkman (Glendo, WY: High Plains Press, 2004), 44, 47, 54, 62, 66, 74, 77, 106-107, 110.

[10] For example, Hayden believed that, seeing that the West would be an agricultural region, unless Native Americans could settle down and start agricultural or pastoral settled communities, they "must ultimately be exterminated.": Ferdinand Vandeveer Hayden, *Preliminary Report of the United States Geological Survey of Wyoming and Portions of Contiguous Territories*; *Being a Second Annual Report of Progress* (Washington: U.S. Government Printing Office, 1872), 263-64.; Richard White, *"It's Your Misfortune and None of My Own": A New History of the American West* (Norman, OK: University of Oklahoma Press, 1991), 85-118.

interactions were necessarily negative, and the bone-hunters nevertheless ventured forth with "imperial eyes" and employed them as guides.[11] Native Americans possessed detailed local knowledge of the physical and political landscape. The Western Tribes were also rich repositories of knowledge about the fossilized remains that littered the landscape.[12] This knowledge was conditionally consulted and often valued solely in terms of the Native American guide's ability to lead the scientist to a rich bed of fossils.

It is likely that Native Americans were the first to find and make sense of North American fossils.[13] This familiarity with fossils infused the worldviews of many tribes of Native Americans in the West. Just as sea serpents haunted the mind of Cope, water monsters swam through the visions of Native Americans who found fossils and fit them into their reality.[14] A degree of common ground could be found through fossils. As material relics of past life, fossils speak as familiar yet novel organic forms. Elements of their meaning can transcend social barriers within cultures and even between distinct

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[11] Mary Louise Pratt, *Imperial Eyes: Travel Writing and Transculturation* (New York: Routledge, 1992).

[12] For histories that examine this knowledge and its relationship to the science of paleontology, see: Lawrence W. Bradley, "Dinosaurs and Indians: Paleontology Resource Dispossession from Sioux Lands" (PhD diss., University of Nebraska, 2010).; Allison M. Dussias, "Science, Sovereignty, and the Sacred Text: Paleontological Resources and Native American Rights," *Maryland Law Review* 55, no. 84 (1996): 84-159.; Adrienne Mayor, *Fossil Legends of the First Americans* (Princeton, NJ: Princeton University Press, 2005).; E. M. Kindle, "American Indian Discoveries of Vertebrate Fossils," *Journal of Paleontology* 9, no. 5 (1935): 449-452.

[13] Mayor, *Fossil Legends of the First Americans*, xxii, xxxii.; An early example of this could have been happened upon by Lewis and Clark when they found a "Petrified jawbone of a fish or some other animal found in a cavern" far from where it would have likely been geologically. It could very well have been put there by Native Americans.: Meriwether Lewis, William Clark, et al., "Fort Mandan Miscellany, Part 4: Mineralogical Collections" entry in *The Journals of the Lewis and Clark Expedition*, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1804-1805.winter.part4.xml&_xslsrc=LCstyles.xsl.;
Mayor, *Fossil Legends of the First Americans*, 189-191.

[14] Adrienne Mayor has insightfully stated, "[s]eeking visions might seem light years from scientific inquiry. Yet the most creative paleontologists can be described as visionaries, and many respected scientists have described important theoretical breakthroughs that came to them as revelations while they slept or daydreamed.": Mayor, *Fossil Legends of the First Americans*, 329.

cultures. Native Americans and Euro-Americans could see in fossils the malleability of the Earth.

Native American fossil knowledge has long been interpreted as "legend" or "myth."[15] Their perspective on fossils was colored by their view of time. Though one must be cautious to generalize, Native Americans often adhered to a cyclical view of time.[16] As will be demonstrated below, the tribes who encountered fossils in the West often saw them not as inert matter, but as remnants of a living past that periodically interjected itself into the present. At times, fossils were also considered to be the remains of creatures that lived out of sync with the correct pattern of life and were therefore destroyed. Fossils taught life lessons and were material evidence for Native American cosmology.

In contrast, even though their data and scientific visions were put to use to bolster the mythic garden West and a faith in progressive evolution, paleontologists entering the western field saw their own use of fossils as utilitarian. Fossils supported elements of western science such as evolution through natural selection, the age of the earth, and the stratigraphic record.[17] The primary difference lay in the ways that the observations of the natural world were put to use. Native Americans sought to continually re-establish and

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[15] Even in Mayor's work that seeks to correct this maligning of Native American knowledge, she uses western science as a benchmark for knowledge and uses the word "legend" in her title: Mayor, *Fossil Legends of the First Americans*.; Bjørnar Olsen, *In Defense of Things: Archaeology and the Ontology of Objects* (Lanham, MD: AltaMira Press, 2010), 11.

[16] Dussias, "Science, Sovereignty, and the Sacred Text…," 98-100, 107.; Black Elk, John Gneisenau Neihardt, and Raymond J. DeMallie, *Black Elk Speaks: Being the Life Story of a Holy Man of the Oglala Sioux*, Premier ed. (Albany, NY: Excelsior Editions, State University Press of New York Press, 2008), 155.

[17] Peter J. Bowler, *Fossils and Progress: Paleontology and the Idea of Progressive Evolution in the Nineteenth Century* (New York: Science History Publications, 1976).; Rachel Laudan. *From Mineralogy to Geology: The Foundations of a Science, 1650-1830* (Chicago, IL: University of Chicago Press, 1987).; Martin J. S. Rudwick, *The Meaning of Fossils: Episodes in the History of Palaeontology* (Chicago, IL: University of Chicago Press, 1985).

correct relationships with their mercurial and unpredictable spiritual and physical universe, while Euro-Americans used experiment to instrumentalize their knowledge so that they could exercise their God-given control over a stable and predictable physical world. [18] The degree to which each culture could potentially control their physical universe broadened the gap between how Native Americans and Euro-Americans saw themselves in relation to each other.[19] Ritual and "medicine" were the Native American sources of power, while Euro-Americans used fossil fuels and other material things as sources of power to ensure their control of their social and material environments. However, this can also be understood as a source of commonality. Both Native Americans and Euro-Americans embraced and utilized the power that was inherent in the

[18] Clara Sue Kidwell, "Native Knowledge in the Americas," 1, Historical Writing on American Science (1985): 209-10.; What has been termed the "uncertainty hypothesis" in anthropology has its roots in the work of Bronislaw Malinowski. The essensce of this hypothesis is that ritual and religion help people think that they have control in an uncertain and unpredictable world. Fossils fit into this framework for both Native Americans and Euro-Americans. For Native American's fossils were *medicine* and explained elements of their relationship to the natural world. For Euro-Americans they often fit into a progressive framework where humans were the ultimate product of time and when they were not fit into the progressive framework they were evidence of a rational universe through which natural selection worked to yield species. More generally, fossils were scientific specimens that supported the epistemological vision of western science. The knowledge generated from the fossils was often put the use for comprehending the natural world so that it could be of use to humanity. For information on the "uncertainty hypothesis," see: Nigel Barber, "A Cross-National Test of the Uncertainty Hypothesis of Religious Belief," *Cross-Cultural Research* 45, no. 3 (August 1, 2011): 318-333.; George Gmelch, "Superstition and Ritual in American Baseball," *Elysian Fields Quarterly* 11, no. 3 (1992): 25-36.; Bronislaw Malinowski, *Magic, Science and Religion and Other Essays* (Glencoe, IL: 1948).; Interestingly, Meriwether Lewis made an observation along these lines in May of 1805. He stated that the Native Americans make sacrifices to their deity in order "to produce the happy eventuation of the important occurrances incident to human nature, such as relief from hungar or mallady, protection from their enemies or the delivering them into their hands, and with such as cultivate, to prevent the river's overflowing and distroying their crops &c." Sargeant Ordway expanded on this and stated, "any thing above their comprehention they Call Big Medisine."; Meriwether Lewis, William Clark, et al., May 2, 1805 entry in The Journals of the Lewis and Clark Expedition, ed. Gary Moulton (Lincoln, NE: University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center, 2005), http://lewisandclarkjournals.unl.edu/read/?_xmlsrc=1805-05-02.xml&_xslsrc=LCstyles.xsl.

[19] As mentioned in Chapter 3, fossil-fueled technology was used as a measure of civilization that set Euro-Americans apart from Native Americans. See also.; Michael Adas, *Dominance by Design: Technological Imperatives and America's Civilizing Mission* (Cambridge, MA: Belknap Press of Harvard University Press, 2006).

material remains of geologic history. Also, Euro-Americans and Native Americans saw that fossils were signs of former environments and illustrated the plasticity of the West.[20]

The incorporation of fossils into Native American cultures and cosmology did not go unrecognized by nineteenth-century scientists. For example, Mammoth remains were found to be fodder for Native American cosmology. This was a recognized fact for scientist-statesmen like Jefferson and Cuvier who had an interest in Native American discoveries and legends that referenced the presence of fossil remains.[21] Also, in his travels through the Americas, Alexander von Humboldt came to believe:

> we cannot doubt, but that, in both America's, the enormous fossil skeletons of animals spread over the surface of the Earth, have had a great influence on mythological history…But whatever be their real origin, it does not appear less certain, that they are fictions of the astronomical mythology, modified either by an obscure remembrance of some great revolution, which our planet has undergone; or according to the physical and geological hypotheses, to which the aspect of marine petrifactions and fossil bones has given rise, even among nations the most remote from civilization.[22]

Several tribes of Western Plains Native Americans also incorporated fossils into their cosmologies and discerned elements of long-gone paleo-environments. They had intimate material knowledge of the rich fossiliferous land and integrated that familiarity into their histories and daily experience. An example from the antebellum period of a detailed description of Native American knowledge of fossils comes from Albert Koch.

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[20] For an exploration of how those interested in the natural world wrestled with its meaning from Mesopotamia to the modern world, see: Peter Harrison, Ronald L. Numbers, and Michael H. Shank, *Wrestling with Nature: From Omens to Science* (Chicago, IL: University of Chicago Press, 2011).
[21] Mayor, *Fossil Legends of the First Americans*, 31, 33, 61-64.; See also Chapter 4 of this dissertation.
[22] Alexander von Humboldt, *Researches Concerning the Institutions & Monuments of the Ancient Inhabitants of America: With Descriptions and Views of Some of the Most Striking Scenes in the Cordilleras!* Vol. 2. Helen Maria Williams trans. (London: Longman, Hurst, Rees, Orme & Brown, J. Murray & H. Colburn, 1814), 21, 25.

The Osage, it was thought, considered Mammoth bones sacred and had incorporated them into a story where huge animals migrating from the East angered the original fauna of the West and provoked a destructive and "terrible battle." The Osages offered some remains of the "monstrous animals" as "burnt sacrifice to the Great Spirit" who buried the remainder under the Big Bone River. The site of the "greatest of these battles" subsequently became "holy ground." Soon this sacred land was occupied by a white settler seeking "permanent residence on this fertile spot." He promised the Osage that he had no intention of desecrating the area. For a time this satiated the original inhabitants, but upon the return of some Osage elders who disagreed with this "violation of the sacred ground" the white man was pushed from his new found home. Dispossession soon took its toll on the Osage and the land fell into the hands of the U.S. government. The white man returned to reclaim the land and in time other settlers arrived. In the process of excavating a mill site, "the labourers found several bones of young mastodons, which excited their curiosity and astonishment."[23] Even though this Osage legend might date to the seventeenth century, one of the primary paths of its transmission was through Koch's 1840s publication and the "Battle of the Monsters" could have been repurposed as a parable to justify Native American resistance to white encroachment beginning in the early nineteenth century.[24]

Koch's biblically-minded geology may have made him more sympathetic to embracing the cosmologically-infused Native American fossil knowledge of the Osage. If

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[23] Albert C. Koch, *Description of the Missourium Theristocaulodon (Koch), or Missouri Leviathan, (Leviathan Missouriensis,) Together with Its Supposed Habits, and Indian Traditions, Also Comparisons on the Whale, Crocodile, and Missourium, with the Leviathan, as Described in the 41st Chapter of the Book of Job* 5th Edition (Dublin: C. Crookes, 1843). 10-12.
[24] Mayor, *Fossil Legends of the First Americans*, 200-201, 206-207.

the biblical tale of the Leviathan that he discussed in his text had its origins in fossilized creatures of the past, could not other traditions have grains of truth embedded and simply awaiting decryption? After discussing the Osage explanation for the presence of Mammoth fossils described above, he indicated that there were definite threads of historical memory embedded in the fossil knowledge offered by Native Americans. Koch cautioned that, "it is perfectly true that we cannot, with any degree of certainty, depend on Indian traditions." However, while they were embedded in "legends," he admitted, "it is equally true that generally these traditions are founded on events which have actually transpired."[25] In a similar sense, as discussed in Chapter 4, in the western tradition science and natural history were put to work with the objective of revealing God's plan and verifying elements of scripture. During the late eighteenth and early nineteenth centuries, many Americans understood the nation's antiquity within the context of the biblical narrative referencing the most revolutionary and cataclysmic event to alter the globe's physical geography.[26]

The Sioux also had incorporated fossils into their cosmology. [27] According to Henry Fairfield Osborn, "[h]uge bones of Titanotheres entombed in the soft rocks of the high plains of the ancient territory of Nebraska had long been known to the Indian tribes in the neighborhood of the Mauvaises Terres or Bad Lands" [Figures 34 and 35]. This

[25] Koch, *Description of the Missourium Theristocaulodon* , 12.
[26] Paul Semonin, *American Monster: How the Nation's First Prehistoric Creature Became a Symbol of National Identity* (New York: New York University Press, 2000), 4, 12.
[27] Dussias, "Science, Sovereignty, and the Sacred Text…," 119.

fossil knowledge was recorded by "Captain John H. Cook of Agate, Nebraska, who acted as guide to Othniel Charles Marsh."[28]

> [A]n ancient Indian legend, dating back to the days before the domesticated horse was introduced to the North American plains by Spanish explorers, ascribed the bones to a 'Thunder Horse' who lived 'way back' and was sometimes sent down to the earth by the Great Spirit under cover of thunderstorms to hunt and kill herds of buffalo for the hungry tribes. The legend goes that on one such occasion the Lacoste tribe were huddled in their village, weak with hunger because the buffalo had wandered far afield and they were unable to pursue him afoot, when the 'Thunder Horse' drove the huge creatures back into the village and the Indians slew great numbers of them with arrow and lance. How the powerful 'Thunder Horse' happened to be dead was not mentioned.[29]

A member of the Sioux tribe visited by Cook named Afraid of Horses had in his possession "a piece of bone, perfectly petrified, containing a molar tooth 3 inches or more in diameter." The fossil tooth, explained Afraid of Horses, "had belonged to a 'Thunder Horse' that lived 'away back' and that then this creature would sometimes come down to earth in thunderstorms and chase and kill buffalo." The "Thunder Horse" could be a benevolent representative of the "Great Spirit" sent to Tribes in times of need.

> His old people told stories of how on one occasion many, many years back, this big Thunder Horse had driven a herd of buffalo right into a camp of Lacota people who were about to starve, and that they had killed many of these buffalo with their lances and arrows. The "Great Spirit" had sent the Thunder Horse to help them get food when it was

[28] Cook will be discussed in the last section of this chapter.
[29] Henry Fairfield Osborn, Helen Ann Warren, and Charles Robert Knight, *Cope: Master Naturalist; the Life and Letters of Edward Drinker Cope, with a Bibliography of His Writings Classified by Subject; a Study of the Pioneer and Foundation Periods of Vertebrate Palaeontology in America* (Princeton, NJ: Princeton University Press, 1931), 20-21.

> needed most badly. This story was handed down from the time when the Indians had no horses.[30]

These relics of the past coexisted with the present in this interpretation of the fossils [Figure 36]. They were not inanimate objects; they were the remains of living beings that periodically intervened in the lives of Native Americans.

The watery West also featured prominently in Native American legends. A Sioux origin story featured "Water Monsters" and "Thunder Beings" that existed in fossilized form in western Cretaceous sediments. One legend provoked by petrified remains speaks of a "Water Monster" by the name of *Untehi*, or *Unktegila* that drowned the ancients with a giant flood that washed over the land. The red pipestone used to create sacred pipe bowls was formed as a result of the flood victim's blood. The "Water Monster" also became stone and was entrapped in the Bad Lands where the evidence of this story was plain to see. There the bones of the "Water Monster" could be viewed protruding from the earth. The Bad Lands themselves were a sacred spot in part due to the abundant stores of fossilized relics, which the Sioux considered signs of the "thunder-beings" who once roamed the earth.[31] In this region, the coincidence of fossils that were clearly creatures of flight with those that were aquatic creatures in the western Cretaceous deposits seemed to indicate to the Sioux that there was a battle which took place between "Thunder Birds and Water Monsters."[32] The Cheyenne found further evidence of this epic conflict in the

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[30] Henry Fairfield Osborn, *The Titanotheres of Ancient Wyoming, Dakota, and Nebraska*, Vol. 1, U.S. Geographical Survey. Monograph (Washington: U.S. Govt. print. off., 1929), xxi.
[31] Dussias, "Science, Sovereignty, and the Sacred Text…," 108-09.
[32] Mayor, *Fossil Legends of the First Americans*, 221.

form of *belemnites* that resembled the petrified arrow point of the Thunderbird's lightning [Figure 37].[33]

The Pawnee were also entranced by the Cretaceous remains in the West and saw them as evidence of a race of giant creatures and a massive flood.[34] They had derived legends from the fossilized remains of marine creatures, which they believed to be water monsters and giant birds.[35] The Pawnee believed that a great flood swept the West and the race of giants that once walked the region were drowned and encased in mud.[36] The Sioux, Cheyenne, and Pawnee understandings of the significance of the fossils of the West indicate that they, along with other Native American tribes, were aware that the landscape was once inundated with water and filled with strange and wonderful creatures.[37] As long-time residents of the West, the living, malleable nature of the landscape did not escape their attention. The flood story is one that is oddly reminiscent of Noah's Flood of the Bible as a god wipes the world clean after his flawed creation displeases it. It also resonates with the actual condition of the seascape of the Cretaceous from which many of the fossils have their origin. Their knowledge not only shows that they were aware that the West was once a sea, but also that the period during which the sea was formed and receded was chaotic and violent.[38] The fossil knowledge of these tribes represented observed realities of the former seascape that left fossilized evidence of

[33] Mayor, *Fossil Legends of the First Americans*, 209-210.
[34] Mayor, *Fossil Legends of the First Americans*, 194.
[35] Mayor, *Fossil Legends of the First Americans*, 189-192.
[36] Mayor, *Fossil Legends of the First Americans*, 174-175.
[37] Mayor, *Fossil Legends of the First Americans*, 189, 191, 197, 211, 212, 224, 229, 237, 239, 257.
[38] Mayor, *Fossil Legends of the First Americans*, 250-51.

its existence in the form of shells and marine creatures for *all* to experience and interpret.[39]

Fossils were also often regarded as *medicine*. As Allison Dussias stated, "[i]n traditional Native American culture, the term 'medicine' means more than simply the curing of disease and the healing of injuries. It encompasses 'that which is mysterious, holy, sacred, and supernatural.'"[40] The fossil knowledge of Native Americans was in effect a variation of *mētis* as James C. Scott defined it: "Broadly understood, mētis represents a wide array of practical skills and acquired intelligence in responding to a constantly changing natural and human environment."[41] This intelligence and understanding is "almost always local" and "depends on an exceptionally close and astute observation of the environment."[42] Native American fossil knowledge was a dynamic and responsive set of beliefs constructed from the physical evidence of the natural world. It worked its way into all facets of Native American life and was reflective of the particular nature of the exposures in arid western environments. The sets of beliefs derived from fossil finds helped to balance Native American lifeways with their environment. The narratives that arose from the fossilized remains of animals and plants brought Native Americans closer to the earth and made petrified earth an active participant in their cosmology.

For example, the field of Custer's folly, Little Bighorn, likely had a number of Native Americans battling under the protection of fossils. *Ammonite* fossils – sea

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[39] Mayor, *Fossil Legends of the First Americans*, 180.
[40] Dussias, "Science, Sovereignty, and the Sacred Text…," 108.
[41] James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Have, CT: Yale University Press, 1998), 313.
[42] Scott, *Seeing Like a State*, 317, 324.

dwelling creatures with spiral chambered shells – were found in the medicine bag from one of Custer's Crow soldiers, White Man Runs Him, and the Sioux Chief Gall who helped defeat Custer possessed an *Ammonite* necklace [Figure 38].[43] Another example comes from the Pawnee man Young Bull who recalled the use of a fossil bone used for healing purposes and "[w]hen smallpox arrived on the Great Plains, recounted Young Bull, the bone helped the Pawnees."[44] The race of giants that had been destroyed by a deluge had powers that were retained in their bones after death. The Pawnee could draw upon those powers by using the fossil bones of these great creatures as *medicine*.[45]

The use of fossils for *medicine* was apparently a widespread practice. Plains Tribes also frequently used *Baculites*—Cretaceous marine fossils related to *Ammonites* that contain fractal patterns resembling buffalo—as "buffalo-calling stones" to summon buffalo each spring.[46] This *medicine* was a vital natural resource for surviving in the West. If a tribe could not call the buffalo, they would surely perish. In the early 1870s, Marsh noted in one of his pocket notebooks that the "Pawnee Indians may have teeth or bones as medicine."[47] Marsh also noted that he used a "half breed" guide who was a "good guide. reliable" to find *Baculites* [Figure 39].[48]

As guides to these scientists, Native Americans helped to advance the same sciences that dispossessed them of their fossil relics and repudiated their knowledge as meaningless mythology. A piece written for the *New York Tribune* in 1875 about Marsh's

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[43] Mayor, *Fossil Legends of the First Americans*, 270-71.
[44] Mayor, *Fossil Legends of the First Americans*, 173-75.
[45] Mayor, *Fossil Legends of the First Americans*, 174-75.
[46] Mayor, *Fossil Legends of the First Americans*, 221-228.
[47] Othniel Charles Marsh, Pocket Notebook 4, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).
[48] Othniel Charles Marsh, Pocket Notebook 1, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT)

collecting endeavor in the Black Hills where he first met Red Cloud, the Sioux Chief that would later become his friend, suggests that Marsh knew that he would have to steal or barter for sacred specimens.[49] The article began by stating that the initial discovery of fossils was made by a Native American and that Marsh had to get to work quickly because "there is no certainty that beds of fossils will remain permanently undisturbed, even where the region is only occupied by savages, for the Indians frequently carry a fossil tooth or bone as an amulet or charm – or as they phrase it, as *medicine*."[50] The Native American discoverer of the fossil that drew Marsh to the location "carried the tooth in his tobacco pouch; his notion about it was that it had belonged to 'a big horse, struck by lightning.'"[51] Marsh knew that they had use for these fossils and he agreed to pay Sioux guides who were likely acquainted with Bad Land fossil sites $1.50 a day to accompany his party. His request for guides served another purpose as well. The guides could keep a watchful eye on the bone-hunters and ease the concerns of the Native Americans unconvinced by his stated scientific intent.[52] Marsh navigated what had become a tense situation in the Black Hills due to recent military incursions, an attempt to make a census of the Sioux, and the spread of gold seekers into the region. A crucial aspect of his success was his diplomacy with the chiefs at the Red Cloud Agency. In particular, he fostered a friendship with Red Cloud who desired that Marsh bring their

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[49] The Black Hills were a particularly sacred spot for the Sioux and the fossils found there likely held special significance.; Dussias, "Science, Sovereignty, and the Sacred Text…," 101-02.; For information on the legal nature of this contested place, see: Edward Lazarus, *Black Hills/White Justice: The Sioux Nation Versus the United States, 1775 to the Present* (New York: Harper Collins Publishers, 1991).
[50] Wyckoff, "A Perilous Fossil Hunt," 259.
[51] Wyckoff, "A Perilous Fossil Hunt," 259.
[52] Mayor, *Fossil Legends of the First Americans*, 260.; Wyckoff, "A Perilous Fossil Hunt," 263.

grievances to the highest levels of government. To his credit, Marsh fulfilled his promise and advocated in Washington for improvements at the Red Cloud Agency.[53]

The conclusion of the 1875 article stated that "the Indians have already found compensation for their 'medicine' ravished to adorn the shelves of Yale's new museum." However, there is no reference as to how they were compensated for the two tons of fossils Marsh extracted from their earth.[54] Their status as *medicine* was destroyed once they made it to their resting place in New Haven. Instead they were seen as inert evidence for evolution through natural selection or diagnostic materials for determining strata. A prime example of this transmutation of fossil meaning across cultures is an *Ammonite* necklace "worn by a medicine man" that Marsh collected during one of his trips to the Bad Lands or Bighorn Basin in the 1870s. It currently resides at the Yale Peabody Museum among the many thousands of fossilized shell specimens in the museum's geology collections.[55]

Prior to his friendship with Red Cloud, Marsh's knew that his paleontological endeavors would require Native American knowledge. In the early 1870s, Marsh had already been scouting Sioux knowledge of the Bad Lands, noting in his pocket notebook

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[53] Bradley, "Dinosaurs and Indians…", 57.; Dussias, "Science, Sovereignty, and the Sacred Text…," 118-20, 156.; Osborn, *The Titanotheres of Ancient Wyoming, Dakota, and Nebraska*, Vol. 1, xxi-xxii.; Charles Schuchert and Clara Mae LeVene, *O.C. Marsh, Pioneer in Paleontology* (New Haven, CT: Yale university press, 1940), 143-168.; Keith Stewart Thomson, *The Legacy of the Mastodon: The Golden Age of Fossils in America* (New Haven, CT: Yale University Press, 2008), 267-70.; David Rains Wallace, *The Bonehunters' Revenge: Dinosaurs, Greed, and the Greatest Scientific Feud of the Gilded Age* (Boston, MA: Houghton Mifflin, 1999), 101-111.; Wyckoff, "A Perilous Fossil Hunt," 259-266.

[54] Wyckoff, "A Perilous Fossil Hunt," 269.; Bradley, "Dinosaurs and Indians," 56.

[55] Mayor, *Fossil Legends of the First Americans*, 269-70.; However, in the Smithsonian Institution, there seems to be some recognition that fossils can also be anthropological specimens. For example, in their anthropological collections there is a Cretaceous oyster listed that was found in Scott County, Kansas.: "Cretaceous Oyster," Site Name: Scott County State Park; Donor Name: Dr. Waldo R. Wedel; Object Type: Shell; Place: Scott County, Kanas, United States, North America; Accession Date: 1944-Oct-06; Topic: Archeology; Accession Number: 168615; USNM Number: A386689-0; Site Number: 14SC1. Smithsonian Insitution.

that he knew of a man with a "Sioux squaw" who "knows all Red Clouds Indians" along with someone Marsh regarded as "best of all guides."[56] Marsh's Yale Expedition of 1870 represented the beginning of his method of manipulating the fossil knowledge of Native Americans to his ends.[57] The specimens he collected with the help of the U. S. military and Pawnee guides from within the Sioux reservation now reside in the Yale Peabody Museum in New Haven, Connecticut.[58] Marsh exploited local knowledge in order to obtain these precious natural resources.[59] The Pawnee guides served as sources of protection, geographic knowledge, and paleontological information. Regarding the protective capacity of these guides, Marsh's student Betts noted, "two Pawnee Indians, undertook to lead us. These guides rode about a mile in advance of the column…the Indians, with movements characteristic of their race, crept up each high bluff, and from behind a bunch of grass peered over the top for signs of hostile savages."[60] The Pawnee were enemies of the Sioux and Cheyenne and after the Civil War had begun to act as regular guides for the U. S. military.[61] Another of Marsh's students, George Bird Grinnell noted, "[n]o one in the outfit, excepting the Pawnee Indians, had ever before been

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[56] Othniel Charles Marsh, Pocket Notebook 2, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT)

[57] For more information on this expedition, see Schuchert, LeVene, *O.C. Marsh, Pioneer in Paleontology*, 94-138.

[58] Bradley, "Dinosaurs and Indians," 7, 12, 41-65.; Dussias, "Science, Sovereignty, and the Sacred Text…," 115-20.

[59] Fossils were valuable natural resources for Euro-Americans as scientific specimens to further their careers or enhance the prestige of a museum, as stratigraphic markers to find other resources such as coal, or simply as decorations for their home. For Native Americans they could be used as "medicine" or serve as a sacred elements of a landscape. Accordingly, as Dussias and Bradley have stated, the removal of fossils from western Native American lands was essentially the theft of a natural resource supported by the government.: Bradley, "Dinosaurs and Indians," 1, 3, 9, 16, 17.; Dussias, "Science, Sovereignty, and the Sacred Text…," 156-159.

[60] Betts, "The Yale College Expedition of 1870," 663.

[61] Bradley, "Dinosaurs and Indians," 43.; Schuchert, LeVene, *O.C. Marsh, Pioneer in Paleontology*, 102-103.; W.R. Echo-Hawk and M. van de Logt, *War Party in Blue: Pawnee Scouts in the U.S. Army* (University of Oklahoma Press, 2012).

through the country."[62] The guides, however, were wary of the prospect of removing the bones from their final resting place.[63]

> [T]he superstition of the Pawnees deterred them for a time from scientific pursuits; for Indians believe that the petrified bones of their country are the remains of an extinct race of giants. They refused to collect until the professor, picking up the fossil jaw of a horse, showed how it corresponded with their own horses' mouths. From that time they rarely returned to camp without bringing fossils for the 'Bone Medicine-man.'[64]

Marsh's expedition benefitted from these Pawnee guides, and later a Shoshoni guide, and from local knowledge of the landscape of the West from where "hunters and Indians had brought back fabulous stories of valleys strewn with gigantic petrified bones."[65] Marsh was well aware of the necessity of using Native American guides and would repeatedly comment on their assistance in his pocket notebooks from the 1870s.[66]

Marsh did not seem to mind that he was taking these natural resources from the Western Tribes. For example, he defended his hold on scientific knowledge and the importance of paleontology in his 1877 address to the American Association for the Advancement of Science (AAAS) titled "Introduction and Succession of Vertebrate Life in America." He began with a firm statement on evolution. "I am sure I need offer here no argument for evolution," he noted, "since to doubt evolution to-day is to doubt

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[62] Grinnell, "An Old-Time Bone Hunt," 332.
[63] Mayor, *Fossil Legends of the First Americans*, 182-84.
[64] Betts, "The Yale College Expedition of 1870," 664.
[65] Betts, "The Yale College Expedition of 1870," 669; Grinnell, "An Old-Time Bone Hunt," 336.
[66] Othniel Charles Marsh, Pocket Notebook 1-12, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).

science, and science is only another name for truth."[67] Paleontology was assisting learned society in getting closer to that truth. Marsh then stated, "the more ancient strata of the earth have been explored, and, in our Western wilds, veritable battle-fields, strown [*sic*] with the fossil skeletons of the slain, and guarded faithfully by savage superstition, have been despoiled, yielding to science treasures more rare than bronze or gold."[68] Marsh did not value the manner in which fossils were put to use in Native American cultures. For him, it was fortuitous not only that they were aware of the fossil wealth of the West, but that Native American cosmologies prevented them from wantonly exploiting these sacred caches of *medicine*.

Likewise, Cope was grateful for the Native American knowledge of fossils for two reasons: first it allowed him to find an able guide to locate rich fossil deposits, and second it "preserved" the fossils for "the more intelligent white man." He had heard that the Sioux "believed that the bones belonged to evil monsters which were slain by lightening by the Great Spirit. They would not touch the bones for fear that a like fate would befall them." But Cope disregarded this as a statement without proof since he was "not troubled by such superstitions." So he entered into the bone field amidst a thunderstorm that "played across the sky in forked streams." However, "the lightening did not avenge the disturbance of the bones of its ancient victims, and we dug them up

[67] Othniel Charles Marsh, "Introduction and Succession of Vertebrate Life in America," an address delivered before the American Association for the Advancement of Science in Nashville, TN (New Haven, CT: Tuttle, Morehouse & Taylor Printers, 1877), 3.
[68] Marsh, "Introduction and Succession of Vertebrate Life in America," 4.

and boxed and shipped them as far as this place, during the next few days." Cope rejected the Native American fossil visions.[69]

The intrepid explorer Hayden also exploited this knowledge in his services as an imperial scientific agent in the West.[70] His experience also shows how Euro-American cosmologies could enter into how fossils were understood. This will be discussed further in the next chapters, but Hayden's experience with a Native American guide serves as a counterpoint to Native American cosmologies supported by fossils. Under the charge of Lieutenant G. K. Warren of the Army Corps of Topographical Engineers, Hayden explored the Bad Lands in 1855. With Native Americans as his guide Hayden played a vital role in documenting the resources of the West for the growth of the American nation and the dispossession of Native American lands.[71] In his travels, Hayden hired "an Indian as guide" so that he could accomplish his "purpose of making a collection of mammalian and chelonian fossils in that remarkable cemetery." The area that they explored had made him think of what he "had imagined of the amphitheatre of Rome, only nature works upon a far grander scale than man."[72]

> We felt very much as though we were in a sepulcher, and indeed, we were in a cemetery of pre-Adamite age, for all around us at the base of these walls and pyramids were

[69] Osborn, Warren, and Knight, *Cope: Master Naturalist*, 429-433.
[70] Mayor, *Fossil Legends of the First Americans*, 57, 226.
[71] Dussias, "Science, Sovereignty, and the Sacred Text…," 112-15.; William H. Goetzmann, *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West* (New York: Knopf, 1966).; William H. Goetzmann, *New Lands, New Men: America and the Second Great Age of Discovery* (New York: Penguin Books, 1987).
[72] G.K. Warren, *Explorations in the Dacota Country in the Year 1855*, 34th Congress, 1st Session, Ex. Doc. No. 76 (Washington: A.O. P. Nicholson, Senate Printer, 1856), 71, 75.; Hayden also received fossil specimens from some local Native Americans the year before. He stated, "In the summer of 1854, I traced it to the mouth of the Big Horn river, and obtained through the Crow Indians undoubted Tertiary fossils from a point two hundred miles further up the river."; Warren, *Explorations in the Dacota Country in the Year 1855*, 68.

> heads and tails, and fragments of the same, of species of which are not known to exist at the present day. We spent the day and the following exploring the cemetery, which the denuding power of water had laid open for our inspection, and many fine specimens rewarded our labors.[73]

Hayden had expected to find turtle fossils in this denuded cemetery. He saw signs of Cretaceous and Tertiary strata all around him and therefore knew that he was fossil hunting in an environment that was far different than the arid Bad Lands.[74] Hayden's fossil hunting was secured by the assistance of his Native American guide who clearly had resided part-time nearby this "sepulcher" amidst the "choice spots of earth."[75] Hayden's use of the term "Pre-Adamite" and comparison to Rome was indicative of his cultural context, and if the Native American guide's perspective were recorded it would have likely also been colored by his culture.

Both cultures often understood fossils for what they were – relics of organic matter. In the American West, the relics were regularly recognized as remains of a watery past. Yet what fossils meant in a wider cosmology depended on how each culture viewed time. Fossils were sacred to many Native American tribes in the West because they were animate matter that could act with force in the present. [76] Fossils were incorporated into cyclical time. For Euro-Americans, fossils supported a semi-cyclical but overwhelmingly progressive vision of time.[77] The danger of the western science paleontological view was that, while it also helped construct Euro-American cosmology and contributed to

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[73] Warren, *Explorations in the Dacota Country in the Year 1855*, 74-75.
[74] Warren, *Explorations in the Dacota Country in the Year 1855*, 73.
[75] Warren, *Explorations in the Dacota Country in the Year 1855*, 73-74.
[76] Dussias, "Science, Sovereignty, and the Sacred Text…," 97.
[77] This will be discussed in more detail in the conclusion and demonstrated in the following chapters.

substantial theories like natural selection, it was no less mythological.[78] This was dangerous because it fed the delusion of science's triumph over mythology and magic. The Euro-American view of fossils was a product of industrial culture, Christianity, and capitalism's inherent objectification of the natural world.[79] The use of coal and steam power fed their fossil visions. The power of these objects was in knowing what they could do and what they could tell humanity about nature. For Native Americans, the power was perhaps not as instrumental or linked to an extractive economic system; power was inherent in fossils regardless of humanity's ability to perceive it. In the Native American system, more knowledge of a sacred cache of fossils did not necessarily translate into exploitation.

Yet, both groups recognized fossils as sources of power and as material evidence of a changing world. Western paleontology has helped feed mythologies that are progress-oriented and place humans at the center of creation, capable of transforming the very nature of the earth. The myth of the garden could only flourish in the face of the

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[78] See, for example the work of Langdon Gilkey: Langdon Gilkey, *Nature, Reality, and the Sacred: The Nexus of Science and Religion* (Minneapolis, MN: Fortress Press, 1993).; Langdon Gilkey, "Nature, Reality, and the Sacred: A Meditation in Science and Religion," *Zygon* 24, no. 3 (September, 1989).; It is necessary for historians, especially historians of science, to consider seeing American history alongside and parallel with Native American history during the nineteenth century. For one, these histories become so entwined that they are hard to separate during that century, but also the Native American understanding and reaction to natural and historical events provide a foil for the privilege regularly placed on the western worldview. For studies that have successfully integrated Native Americans into American history, see: Dee Alexander Brown, *Bury My Heart at Wounded Knee: An Indian History of the American West* (New York: H. Holt, 2001).; Colin G. Calloway, *One Vast Winter Count: The Native American West before Lewis and Clark* (Lincoln, NE: University of Nebraska Press, 2003).; Kathleen DuVal, *The Native Ground: Indians and Colonists in the Heart of the Continent* (Philadelphia, PA: University of Pennsylvania Press, 2006).; Pekka Hämäläinen, *The Comanche Empire* (New Haven, CT: Yale University Press, 2008).; Karl Jacoby, *Shadows at Dawn: A Borderlands Massacre and the Violence of History* (New York: Penguin Press, 2008).; Daniel K. Richter, *Facing East from Indian Country: A Native History of Early America* (Cambridge, MA: Harvard University Press, 2001).

[79] Carolyn Merchant, *The Death of Nature: Women, Ecology, and the Scientific Revolution* (New York: Harper & Row, 1989); Keith Thomas, *Man and the Natural World: Changing Attitudes in England, 1500-1800* (New York: Oxford University Press, 1996); Lynn White, "The Historical Roots of Our Ecologic Crisis," *Science* 155, no. 3767 (1967): 1203-1207.

harsh physical realities of the arid West in a society that used the authority of science and technofaith to delude itself enough to think that they were environmental alchemists capable of turning sand into water. It was not as if Euro-Americans had never embraced an organismic and vibrant natural world that permeated their bodies and affected their very being.[80] Rapid technological advances associated with the increasing use of fossil fuels and the expansion of capitalism demolished any humility remaining in the human-centered-rational-mechanistic worldview that had come into being in the sixteenth century. As demonstrated in Chapter 3, in the late-nineteenth century American West, the railroads encapsulated these ideologies and played the part of this bogeyman. By reconciling Euro-American science and technofaith with Native American knowledge systems, perhaps insight can be gained into the essence of the human experience with the material world.[81] In this case, these two groups both saw the world's impermanence through fossilized remains.

Amateur Fossil Collectors of the West:
The Malleable West in the Hands of Westerners

Not only were geologists, miners, government surveyors, paleontologists, fossil hunters, and Native Americans intrigued by fossilized flora and fauna, the growing population of western settlers also wondered about these relics of worlds long-past. Doctors, missionaries, and traders at the many military forts on the western frontier often filled their leisure time looking for natural curiosities. Settlers interested in natural history

[80] For example, see: Conevery Bolton Valenčius, *The Health of the Country: How American Settlers Understood Themselves and Their Land* (New York: Basic Books, 2002).
[81] Fulvio Mazzocchi, "Western Science and Traditional Knowledge," *EMBO reports* 7, no. 5 (2006): 463-466.

also used the security granted by these forts and the railroads to locate lands to settle. Working and travelling the rugged western lands was hard work, but it inevitably provided these migrants with an intimate knowledge of the natural world. Scientists sought this local knowledge to help broaden their gaze over the vast western field. The growing network of settlers allowed greater access and exposure to previously undiscovered caches of fossil remains. The deep past became increasingly familiar to this growing population that had everyday experience of the material remains of the ancient West. A broad spectrum of interpretations and visions emerged from seeing and touching the deep past, influenced by each individuals' education, upbringing, aspirations and dreams.

This section will examine the public's encounters with fossils and their interactions with paleontologists, demonstrating that fossils were not just obscure items coveted by bespectacled scientists. Fossils were fascinating curiosities for many westerners and they often made natural history collections of their own, which they shared with scientists. The section begins in the antebellum period with the locals involved in the excavation of Charles Willson Peale's Mammoth in New York State. After the Civil War, scientists called upon curious westerners to send their fossil specimens and knowledge of their region's natural history to paleontologists like Edward Drinker Cope and to eastern centers of learning such as the Smithsonian Institution. Networks of collectors developed that helped advance American paleontology. Doctors to railroad workers cooperated as collectors and sources of fossil knowledge for scientists seeking evidence of the deep past and evolution. They were helped in the field by locals,

though at times this help could harm their precious specimens. Paleontologists and fossil hunters reciprocated by educating locals about their finds. The section will conclude with a discussion of an exceptional example of a rancher turned fossil field proprietor by the name of James Cook, the same man who helped Marsh take *medicine* from the Sioux.

The public's appetite for fossils and collaboration in their excavation was present during the early nineteenth century. For example, the Mammoth which was discussed in the previous chapter, often made its way into the American public's mind through museums. One particularly famous museum was that of Charles Willson Peale.[82] Before it could become the centerpiece of this museum, this ancient creature had to be wrestled from the earth. At the turn of the century, Peale made a deal with the *pater familias*, John Masten, of the Masten farm in Orange County, New York, where in exchange for three hundred dollars, a double barrel shotgun, and a wedding dress, Peale would be able to retain specimens he had already collected and continue to search for more Mammoth remains.[83] It was a cantankerous quarry and Peale used his wits to outsmart the natural obstacles that sought to hold on to the mired ancient remains. The remains were found in a marle pit dug to obtain fertilizer for cultivating "the most luxuriant crops."[84] Initially,

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[82]John C. Greene, *American Science in the Age of Jefferson* (Ames, IA: Iowa State University Press, 1984), 33.; Mark V. Barrow, *Nature's Ghosts: Confronting Extinction from the Age of Jefferson to the Age of Ecology* (Chicago, IL: University of Chicago Press, 2009), 18.; Thomson, *The Legacy of the Mastodon*, 53.

[83] Barrow, *Nature's Ghosts*, 35.; Rembrandt Peale, *An Historical Disquisition on the Mammoth, or, Great American Incognitum an Extinct, Immense, Carnivorous Animal, Whose Fossil Remains Have Been Found in North America* (London: E. Lawrence, 1803), 22-23.

[84] Peale, *An Historical Disquisition on the Mammoth*, 19.; Locating fossils in fertilizer directly compares to finding fossils in coal. Fertilizer is in a sense an agricultural fuel, while coal was an industrial fuel. The marl from which the fossil was extracted was likely shell marle. As mentioned in Chapter 4, Peale himself noted that shells were often located with Mammoth bones. Shell marle is a paleo deposit that was used for fertilizer. According to an 1843 volume of the *Natural History of New York*, [t]he term marl, in its strict mineralogical sense, means an argillaceous carbonate lime…which by being spread upon the soil, renders it more fertile." In particular, in the place where Peale was digging, Orange County, "this marl is much used by the farmers, and with great advantage to their crops." In a sense this was similar to finding fossils in coal

the fossils provoked no interest in the German farmer's mind as they had no use to him in his daily labors and maintenance of his farm. It was not until Masten became aware of the possible significance of these old bones that he decided to engage his energies in their excavation. According to Rembrandt Peale, "the learned physician, and the reverend divine, to whom he [Masten] had been accustomed to look upwards, gave importance to the objects which excited the vulgar stare of his more inquisitive neighbors: he therefore joined his exertions to theirs."[85] The Masten marle pit attracted around a hundred men led by local physicians to excavate the curious remains accidentally acquired by the farmer. Unfortunately the laborers, as was their habit, became inebriated and frustrated in the mucky marle pit and damaged a number of the fossils.[86] As can be seen in his 1806 painting, the drowned diggings required an innovative approach using a mill wheel and a large number of volunteers [Figure 40]. The elder Peale's son, artist and naturalist Rembrandt Peale, assisted in his excavation by designing a device that assisted in locating fossils. With these two technological innovations for fossil excavation, the Peales pieced together two complete skeletons where "[n]othing in either skeleton is imaginary" for their museum.[87]

(another form of fossilized fertility).; *Geology of New-York* Part 1 (Albany, NY: Carroll & Cook, Printers to the Assembly, 1843), 11-12.; Devonian limestone is probably the source for the shelly marl. There is not necessarily a geological correlation between shell marl and Mastodons, but rather that farmers were mining this resource and there were likely Mastodon bones all over the place. Since that is where they were digging for this form of fossilized fertility that is where they located these fossils. It is possible that there may be a correlation since the faults yielded areas where deposits were more likely to remain buttressed against hard bedrock. It is unclear how fossilized remains of Mammoth's would have remained under glacial action since it is a very forceful process. It is possible that as a result of a series of growth and recession of ice sheets where thawing formed swamps and anoxic conditions for preservation.

[85] Peale, *An Historical Disquisition on the Mammoth*, 22.

[86] Peale, *An Historical Disquisition on the Mammoth*, 20.; There may have been an African American slave employed in this work as well. Peale noted, "nothing could exceed the ardour of the men, particularly of one, a gigantic and athletic negro."; Peale, *An Historical Disquisition on the Mammoth*, 28.

[87] Barrow, *Nature's Ghosts*, 36.; Peale, *An Historical Disquisition on the Mammoth*, 48.

The bustling activity and large contraption built around the Masten marle pit did much to excite the minds of passersby. Its geographic location close to the road made it a destination for tourists and travelers. Rembrandt Peale's recollection of the event revealed the diversity of curious visitors to their labors for natural history.

> The road which passed through this farm was a highway, and the attention of every traveller was arrested by the coaches, waggons, chaises, and horses, which animated the road, or were collected at the entrance of the field: rich and poor, men, women, and children, all flocked to see the operation; and a swamp always noted as the solidary abode of snakes and frogs, became the active scene of curiosity and bustle.[88]

The denizens of deep time took hold of the popular imagination and ran through the minds of all classes. It is likely that their interpretations varied and fell somewhere on the wide spectrum from biblical literalist evidence of the Flood, to the bones of a giant race of men, to the remains of long extinct animals.

The public's growing interest in fossils during the latter part of the nineteenth century can also be seen in the ways in which well-known fossil collectors like Cope made repeated use of lay knowledge and amateur prospecting. Cope was fully aware of the importance of the assistance of collectors in the West. Accordingly, in his second report he requested those who live in the West to send him the curiosities they came across. "As it is desirable to develop the science of geology," Cope stated,

> the writer would be glad if his friends in the West would forward to him, in Philadelphia, at his expense, specimens of bones or teeth which they may find. He will return to them determinations of their nature, and credit them with

[88] Peale, *An Historical Disquisition on the Mammoth*, 25.

> discoveries which may result from their care and interest in preserving them, in the publications of scientific bodies.[89]

Cope sought to entice his potential pool of collectors with the promise of the immortality of scientific credit. As will be discussed in Chapter 6, one of Cope's collectors by the name of William E. Webb wrote a piece of booster literature that cited extensively from Cope's imaginative journeys and used them to override desert imagery and paint a picture of an ever-changing West. This suggests that the relationship was indeed reciprocal. The network of collectors and friends that he had already established had clearly borne fruit in the construction of these reports as there are repeated references to individuals who either assisted him in collecting or contributed specimens to Cope's collection.[90] These collectors no doubt traveled through time using the fossils of the West as conduits carrying them to the deep past and showing them the malleability of their surroundings. The fossils themselves also travelled through time as they were carefully packaged and sent east on the iron horse. The past, present, and future were all blended together during this period of flux and industrially-powered westward expansion.

Public interest in science was democratized during much of the late nineteenth-century. Many Americans saw science as a worthwhile enterprise and took advantage of local informal and institutional avenues for scientific education. As a result, scientific literacy spread beyond the borders of the eastern centers of learning and into the West.[91]

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[89] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 386.
[90] For example, see: Ferdinand Vandeveer Hayden, *Preliminary Report of the United States Geological Survey of Montana, and Portions of Adjacent Territories; Being a Fifth Annual Report of Progress for the Year 1871* (U.S. Government Printing Office, 1872), 336, 348.
[91] Daniel Goldstein, "'Yours for Science': The Smithsonian Institution's Correspondents and the Shape of Scientific Community in Nineteenth-Century America," *Isis* 85, no. 4 (Dec., 1994), 583.; Daniel Goldstein, "Outposts of Science: The Knowledge Trade and the Expansion of Scientific Community in Post–Civil War America." *Isis* 99, no. 3 (2008): 519-546.

Field collectors and amateur scientists were important for institutions such as the Smithsonian because they regularly sent specimens to be identified by experts at the institution. Spencer Baird of the Smithsonian was a "collector of collectors," whose correspondence reveals that he was a tireless and sincere steward of those who sent him scientific riches.[92] These individuals were willing to give up duplicates and possible type specimens of new species, which helped to make the Smithsonian collections internationally renowned.[93] As the United States expanded into the West, vast regions were open for natural history exploration by locals and Smithsonian-sponsored explorers informed by local settlers familiar with the territory.[94] As the nineteenth-century ended and the frontier was closing, the lines drawn between professional and amateur became well-defined and hierarchies of scientific authority were enforced.[95] The fossil fuels that empowered increasing specialization also powered the authority of a select pool of experts who could claim the status of scientist. At the same time, rapid industrialization had shown Americans the power of science and technology in altering and harnessing the natural world. The effect of these historical currents ensured that a scientist's message of the malleability of the West could quickly become gospel.

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[92] Edward F. Rivinus and E. M. Youssef, *Spencer Baird of the Smithsonian* (Washington: Smithsonian Institution Press, 1992), 81-97.; Like Baird, James Hall collected amateurs to collect fossils for his science.: John W. Wells, "James Hall's Amateurs," *Earth Sciences History* 6, no. 1 (1987): 34-39.; American naturalists also communicated, networked, and exchanged specimens using the *Naturalists' Directory*.; Samuel E. Cassino, *The Naturalists' Directory. Containing the Names of Naturalists, Chemists, Physicists, & Meteorologists, Arranged Alphabetically, with an Index Arranged According to Departments* (Salem, MA: The Naturalists' Agency, 1877).; Vernon N. Kisling Jr., "*The Naturalists' Directory* and the Evolution of Communication among American Naturalists," *Archives of Natural History* 21, no. 3 (1994): 393-406.
[93] Goldstein, "'Yours for Science': The Smithsonian Institution's Correspondents…", 588, 591.
[94] Goldstein, "'Yours for Science': The Smithsonian Institution's Correspondents…", 591.
[95] Goldstein, "'Yours for Science': The Smithsonian Institution's Correspondents…", 590-593.; For more information on the lay-expert divide and its inherent messiness, see: Jeremy Vetter, "Introduction: Lay Participation in the History of Scientific Observation," *Science in Context* 24, no. 02 (2011): 127-141.

A sampling of the public's interest comes from the Smithsonian Institution's efforts to gauge their correspondent's scientific interests. During the late nineteenth century, the Smithsonian Institution sent out circulars that solicited information from American citizens concerning any scientific objects that they had collected and asked what subjects caught their attention. Circulars from the year 1875 serve as an excellent source to gauge the public's interest in geology and paleontology. This period was characterized by an early railroad-assisted flood of emigrants into the West after the Civil War. As individuals had begun to settle the region, many citizen-scientists began to explore their local geographies. In these circulars, the States and Territories west of the Mississippi were represented by a variety of professions. There were professors, farmers, merchants, postmasters, doctors, real estate dealers, editors, lawyers, civil engineers, surveyors, artists, soldiers, minsters, quarrymen, railroad workers, and domestic workers.[96] Common among many of the correspondents regardless of their professed scientific interest were geological or paleontological collections. The reason for this was likely the result of the material nature of these natural history specimens. As opposed to other perishable, organic specimens, those made of rock were easily found in the natural world and simple to keep in a cabinet or on a shelf. The curious nature of fossils and their material nature made them common collectables for westerners. For example, even a "House-Mother" from Iowa with "very little leisure or chance to pursue the study" of natural history had a "collection of minerals, shells, sea mosses, petrifactions, savage

[96] "Answers to Circulars." Smithsonian Institution Archives. SIARU007002 Box 64 Folders 1-11, and Box 63 Folders 17-20.

weapons &c."[97] In certain locations, fossils were particularly abundant and became the focus of an individual's collection. For example, a man employed in real estate and stock raising in Colorado listed no particular scientific interest but noted he had a collection of "fossils and minerals – varied + abundant in the neighborhood."[98] Furthermore, a number of collectors were quite generous with their scientific specimens. For example, a farmer on the Santee Agency in Nebraska stated that he had no collections as he had "generally handed over any specimens which I have gathered to public Institutions as being of the most benefit."[99]

Western doctors were a particularly fertile source of fossil finds. Being of a scientific turn of mind, the doctors at military forts often spent their free time collecting natural curiosities. Medical degrees often were a substitute for a wide variety of advanced degrees in early American science due to the lack of formal programs for scientific study at American institutions of higher education.[100] Consequently, physicians performed a lot of respectable geological work during the nineteenth century.[101] Many who were interested in investigating the natural world were forced into the more practical field of medicine but nonetheless retained their wider curiosity. Dr. George M. Sternberg, Charles H. Sternberg's brother, was a post surgeon for the U. S. Army who informed prominent paleontologists of Kansas' fossil caches. In the late 1860s and early 1870s, Dr.

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[97] "Answers to Circulars, Uhler – Younglove." Smithsonian Institution Archives. SIARU007002 Box 64 Folder 10.
[98] "Answers to Circulars, Bois – Byrnes." Smithsonian Institution Archives. SIARU007002 Box 63 Folder 19.
[99] "Answers to Circulars, Talbot – Tyson." Smithsonian Institution Archives. SIARU007002 Box 64 Folder 9.
[100] Robert V. Bruce, *The Launching of Modern American Science, 1846-1876* (Ithaca, NY: Cornell University Press, 1987), 90-91.
[101] Richard Paul Boekenkamp, "Geological Education in the United States During the Late Nineteenth Century" (PhD diss., Ohio State University, 1974), 9.

Sternberg collected many fossils in Kansas that ended up in the U. S. Army Medical Museum and later in the Smithsonian.[102] Marsh's pocket notebooks from the 1870s refer to a couple of inquisitive physicians. Marsh noted, "Dr. C. A. White Iowa City has collection of Cret[aceous] fish remains from Sioux City."[103] Also mentioned in Marsh's pocket notebook is, "Dr. Morris J. Asch, Gen Sheridan staff [who] collected Ammonites Sun River near ft. Shaw Montana."[104] Like Marsh, fossil hunter Albert Thomson took advantage of local knowledge and while working on Pine Ridge Reservation in 1907 he received a fossil skull of an *Elotherium* from a Dr. Walker.[105] Exactly what these doctors thought of the fossils is unknown, though with their medical training they were likely more than competent to consider their anatomical associations and relationship to the history of life on Earth.[106]

Professor O. C. Marsh's pocket notebooks reveal the degree to which he relied on others in his successful searching for specimens. Marsh used railroad passes to travel through Kansas and used the reconnaissance of amateurs who located fossils in the

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[102] Michael Everhart, *Oceans of Kansas: A Natural History of the Western Interior* Sea (Bloomington, IN: Indiana University Press, 2005), 17-18.; Though by 1875, George M. Sternberg professed his interest primarily lay in "Ethnology & especially American Archeology.": "Answers to Circulars, Safford – Swiggert." Smithsonian Institution Archives. SIARU007002 Box 64 Folder 8.; For more information on Dr. Sternberg, see: John M. Gibson, *Soldier in White: The Life of General George Miller Sternberg* (Durham, NC: Duke University Press, 1958).; Martha L. Sternberg, *George Miller Sternberg: A Biography* (Chicago, IL: American Medical Association, 1920).

[103] Othniel Charles Marsh, Pocket Notebook 2, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).

[104] Othniel Charles Marsh, Pocket Notebook 4, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).

[105] Albert Thomson, "Expeditions in Charge of Albert Thomson: Rosebud: - 1906-7. Agate Springs, Neb.: 1908, 1911-14, 1916; 1919, 1920. Snake Creek, Neb. - 1918, 1921, 1922, 1923, 1925, 1926," in *Archival Field Notebooks of Paleontological Expeditions*, American Museum of Natural History Paleontology Division. http://research.amnh.org/paleontology/notebooks/thomson-1906/.

[106] For another example, see: Kenneth J. Almy, "Thof's Dragon and the Letters of Capt. Theophilus H. Turner, M.D. U.S. Army," *Kansas History* 10 (Autumn 1987): 170-200.

western field.[107] One was a missionary referred to solely as Mr. Platt. In 1870, Marsh wrote that, "At Pawnee Reservation (on Loup Fork of Platte) 20 m W of Columbus UPRR is Mr. Platt missionary who has collection & would assist in collecting."[108] Marsh suspected that while preaching to the Native Americans Platt may have acquired fossil knowledge from his Pawnee flock.[109] Like many of his day, it is likely that Platt simply had an amateur's interest in the study of fossils and thereby became a local authority on mining for what he may have thought of as ancient monsters. Once again, we see the pairing of religious fervor and fossil prospecting. Fossil knowledge did not require a single interpretation of their origins and meaning, nor were the spheres of religion and science incommensurable.

Scientists and fossil hunters also found that western judges were a great source of fossil knowledge. The twenty-two-year-old Albert Peale of the 1871 Yellowstone Expedition hailed from famous forebears and as such had western exploration and natural history running through his veins.[110] Peale's diary detailed moments where the party made contact with occupants of the West who had touched and imagined the deep past. The party encountered many settlers and travelers as they traveled through the West and

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[107] Othniel Charles Marsh, Pocket Notebook 1, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).
[108] Othniel Charles Marsh, Pocket Notebook 1, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).
[109] Othniel Charles Marsh, Pocket Notebook 4, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).
[110] Albert was the great-grandson of the aforementioned Charles Willson Peale. His great-uncle Titian R. Peale participated as the naturalist on the 1819-1820 expedition to Rocky Mountains led by Stephen H. Long, where Long reinforced the image of the "Great American Desert." As a budding scientist, he was under the tutelage of Hayden who regarded him as "a young man of the right stamp."; Merrill, *Yellowstone and the Great West*, 25-26, 177.; Stephen H. Long, "A General Description of the Country Traversed by the Exploring Expedition: Being the Copy of a Report of Major Long to the Hon. J. C. Calhoun, Secretary of War, Dated Philadelphia, Jan. 20. 1821," in Reuben Gold Thwaites ed., *Early Western Travels*, Vol. XVII (Cleveland, OH: The Arthur H. Clark Company, 1905), 147-148.

likely spoke of their discoveries in casual conversation over a glass of milk, dinner, or cup of coffee.[111] They also obtained fossils from curious westerners. For example, in the rough-and-tumble mining town of Virginia City on July 5, 1870, Judge Lovell gave the party a Mastodon tusk and other fossils that were located around the city.[112] Similarly, in his journeys in 1877, Arthur Lakes came to Castello's Ranch which he described as "a little village of which Judge Castello is the Lord and Master."[113] As a guest of Judge Castello, Lakes was warmed by his hospitality and hearth where "the logs were burning in a large open fire place the pillars and mantelpiece of which were quaintly enough formed by big blocks of the petrified stumps of the basin and the walls of Miocene shales entombing abundance of beautiful leaf impressions and fossil insects."[114] This was not an uncommon practice for Americans encountering fossils in the West. Another example comes from the paleobotanist and sociologist Lester F. Ward's 1896 fieldwork. While in Kansas, he received some fossil prospecting assistance from a farmer's wife who showed him a large fossilized tree trunk that she had used as a planter and gave him a large specimen for his scientific work.[115]

Western traders also took part in the fossil frenzy. Marsh noted, "Frank Yates, Trader at Spotted Tail. gave bones to P. H. Wilson Cheyenne who gave them to OCM./

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[111] Merrill, *Yellowstone and the Great West*, 66, 81, 100-101, 105, 121, 131, 184, 188, 189, 191.
[112] Merrill, *Yellowstone and the Great West*, 102.
[113] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 48.
[114] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 48.
[115] September 23, 1896. "Note-book No. 8 of Lester F. Ward: July 1, 1895 to December 31, 1896," Smithsonian Institution Archives. SIA Acc. 07-041 Box 2. "Lester F. Ward 7/1/1895-12/31/1896 + 1/2/1897 – 12/29/1898."; Another instance comes from Ward's prospecting in South Dakota where he found fossil cycads decorating the front yard of a man's house. But he was unwilling to part with the specimen. Near the local school, in Hot Springs, South Dakota, Ward also found fossils in a pile of broken rock sitting in someone else's front yard.: October 9-10, 1898. "Note-book No. 5 of Lester F. Ward: October 3, 1896 to June 23, 1901," Smithsonian Institution Archives. SIA Acc. 07-041 Box 2. "Lester F. Ward 10/3/1898-6/23/1901 + 1/3/1899 – 6/30/1904."; For biographical information on Lester F. Ward, see: Emily Palmer Cape, *Lester F. Ward: A Personal Sketch* (New York: G. P. Putnam's and Sons, 1922).

Francis C. Boucher Indian Trader Spotted Tail will get fossils."[116] Sternberg also received fossil hunting advice from "an old line hunter [of buffalo], Abernathy" who directed him to a very large specimen of "a monster turtle" that lay near his cabin.[117] Given the popular fascination with these relics that will be discussed in more detail in Chapter 6, the fossils could have been remunerative for the traders. Public interest was such that even prominent Montana pioneers such as Granville Stuart played a role in fossil prospecting, providing fossils to the famous Marsh.[118]

Railroad engineers also recognized fossils and brought them to the attention of paleontologist or geologists. It was often the case that survey parties overlapped and interacted in the western field. While on the 1871 Yellowstone Expedition, Peale noted, "[t]here is a party of engineers [with] the Northern Pacific Railroad in camp here. They will go the route we took until they reach the valley of the Yellowstone, and will go down the river until they meet a party which is on the way up. They expect to be out until next January, and will take with them a strong escort of cavalry from the post."[119] They undoubtedly observed the same formations and encountered similar outcrops as they surveyed the land. For example, Marsh noted in his pocket notebook, "Engineer U.P.R.R. Evanston…has fine spec from Green R."[120] Similarly in the fourth USGS report, when referring to the Bear River fossiliferous railroad cut exposures, Hayden employed the

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[116] Othniel Charles Marsh, Pocket Notebook 11, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).
[117] Sternberg, *The Life of a Fossil Hunter*, 120-122.
[118] Othniel Charles Marsh, Pocket Notebook 7, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).; For more information on Granville Stuart, see: Victor C. Dahl, "Granville Stuart: Author and Subject of Western History," *Pacific Historical Review* 39, no. 4 (1970): 493-511.
[119] Merrill, *Yellowstone and the Great West*, 178-179.
[120] Othniel Charles Marsh, Pocket Notebook 8, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).

services of Mr. H. R. Durkee, a Union Pacific Railroad "civil engineer of great skill in his profession, and an excellent geologist," who described the "sections of these curiously variegated strata."[121] Durkee had also sent specimens to the Smithsonian Institution.[122] Hayden knew that he could draw upon the knowledge of these men for the purpose of his surveys. "Many of the observations also," Hayden asserted, "which were made for practical purposes by the engineers, as well as the exploration for useful minerals in the vicinity of the road, may be brought into the service of science."[123]

Sometimes what was needed, however, was just a little muscle. Sternberg received assistance in the field that made life a little easier. In Kansas, Sternberg tells of the heavy lifting that had to be done to excavate some major finds, stating, "I should like just here to express my gratitude to those ranchmen who gave their time and strength to assist me in handling these huge specimens."[124] Also, in 1898, a paleontologist form the American Museum of Natural History, William D. Matthew, took advantage of the local knowledge of a Mrs. Barnes and the "Dupree Boys" to locate fossils in his field expedition that covered Nebraska, Kansas, and Eastern Colorado.[125] Once again, even if lay westerners did not appreciate fossils in the same manner as scientists, field

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[121] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 150.
[122] Clarence King, "United States Geological Exploration of the Fortieth Parallel," ed. U.S. Army, Professional Papers of the Engineer Department, U.S. Army. (Washington D.C.: Government Printing Office, 1877), 169, 174.
[123] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 85.; Lester F. Ward also received assistance from a geologists from a Kansas railroad company whose cousin gave Ward a "remarkable specimen" and fossil hunting advice in Kansas.: September 19-21, 1896. "Note-book No. 8 of Lester F. Ward: July 1, 1895 to December 31, 1896," Smithsonian Institution Archives. SIA Acc. 07-041 Box 2. "Lester F. Ward 7/1/1895-12/31/1896 + 1/2/1897 – 12/29/1898."
[124] Sternberg, *The Life of a Fossil Hunter*, 90-91.
[125] W. D. Matthew, "Jurrasic, Laramie Basin, 1898, W. D. Matthew, Am. Mus. Nat. Hist. Central Park W. New York," in *Archival Field Notebooks of Paleontological Expeditions*, American Museum of Natural History Paleontology Division. http://research.amnh.org/paleontology/notebooks/matthew-1898a/.

paleontologists required the use of available local knowledge in order to accomplish their fossil hunting objectives.

Paleontologists also hired local muscle to assist in their western diggings. For example, Barnum Brown's relationship with locals was not limited to hospitality and guide service; he also hired field workers to assist with his excavations. At one point, a man by the name of Lambert quit due to the hard nature of the work. Brown was relieved as he considered him "one of the greatest gass bags I ever hired." He was quickly replaced by a "Norwegian by the name of Johnson" who had recently quit a ranch job.[126] Brown also experienced the cosmopolitan nature of the growing western population and during this trip he met "two Italian peddlers who wanted to sell us something."[127] As the West was becoming increasingly settled, and the frontier had officially come to a close at the end of the nineteenth century, paleontologists such as Brown could typically rely on dependable transportation to the field and on a growing population of willing collaborators in their scientific endeavors.

Yet, as Brown's experience with his field worker Lambert indicates, not all interactions with locals were favorable. There could also be issues associated with ignorance when hiring field laborers. For example, Arthur Lakes also hired laborers to facilitate his excavations and required the occasional assistance from locals in working the fossil quarries, but not all of these experiences were beneficial.[128] In one instance, "[a] farmer who was passing joined us and lent his powerful arm to the sledge hammer

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[126] Barnum Brown, "Field Book: Barnum Brown 1908: Hell Creek Beds – Montana," in *Archival Field Notebooks of Paleontological Expeditions,* American Museum of Natural History Paleontology Division. http://research.amnh.org/paleontology/notebooks/brown-1908/.
[127] Brown, "Field Book: Barnum Brown 1908: Hell Creek Beds - Montana."
[128] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 23.

and soon we clove the block but the bone was badly shattered."[129] Lakes understood that more often than not his helpers were unaware of the scientific significance of these fossilized remains. He expressed this while experiencing a tense transportation experience in which they laid their finds in "the wagon bed but my agony was great as our young charioteer, anxious to return home before it grew dark, drove furiously over the rough country and threatened the further dissolution and fracture of our skeleton: the value of which was but little considered by the good people of the village."[130] While the value of these fossils to science may have escaped Lakes' amateur assistants, they were still intrigued by the remains and aware of their significance in revealing the malleability of the environment.

The West was also home to amateur collectors who did not have the training to properly extract fossils from their substrate. For example, in 1897, American Museum of Natural History paleontologist H. J. Martin explored the Cretaceous of Kansas and came across some fortunate and not-so-fortunate impacts of amateur collectors on the paleo-past of the West. Making his job easier, Martin located a vertebrae "dug out by some ameteur [sic] and left on a rock."[131] Laborers also worked in the West with little care as to their impact on these scientific specimens. An example of this comes again from Martin when to his dismay he found some wing bones of a *Pterodactyl* in a stone quarry that "Quarrymen had broken up."[132] Not everyone appreciated the value placed on these

[129] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 22.
[130] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 12.
[131] H. J. Martin, "Martin, H. J. 1897 Kansas Cretaceous Expedition," in *Archival Field Notebooks of Paleontological Expeditions*, American Museum of Natural History Paleontology Division. http://research.amnh.org/paleontology/notebooks/martin-1897/.
[132] Martin, "Martin, H. J. 1897 Kansas Cretaceous Expedition."

specimens by scientists. A fossil could simply be a nice curiosity to be used as a home decoration or a piece of useless quarry stone. Yet, it is likely that these remains provoked at least a minor amount of mental energy applied to imagining their origins.

Absent scientific training in paleontology, it is likely that the fossils bore different meaning to these people, but still carried the message of malleability. The fossils could speak in a wider variety of ways to those whose minds were not constrained by the strictures of paleontological practice. These amateur prospectors were presumably curious about the world around them and could identify fossils when they located them in the western field. Due to the nature of preservation potential and the bias of the fossil record, most of these were fossils of aquatic flora and fauna. It is entirely possible that their interpretation of these fossils diverged sharply from the meaning that paleontologists ascribed to them. However, these amateur fossil prospectors nonetheless assisted in the advancement of American science and were likely influenced by the meanings they attributed to the abundant fossils strewn about the American continent. The fact that the interpretations of Native Americans aligned so closely with the visions of paleontologists suggests that those who encountered fossils in the field could not help but to ponder the plasticity of their environment.

There are occasional moments of insight available in historical documents indicating what some westerners thought of the fossils that could be found around their homes. For example, in Charles H. Sternberg's fossil prospecting adventures he met westerners interested in his work. On one such occasion, he met an illiterate "old gentleman" who admitted to being interested in "old bones" but the man made a point of

mentioning that he did not "claim to be a scholar; in fact, I am quite illiterate, but I think when this earth was in a molten state, these old hippopotamuses wallowed around in the mud and got congealed in the rocks."[133] However, these accounts are rare and while we may not know exactly what these individuals thought, some fossil hunters and paleontologists sought to educate westerners in the nature of their fossil finds. Three such individuals who participated in the practice of spreading paleontological knowledge to westerners were Arthur Lakes, J. P. Sams, and Barnum Brown. Their accounts illustrate the interest many westerners had about fossils, that time was spent to educate these individuals, and they yield some indication as to how fossils were seen by the public.[134]

While borrowing a sledge from some men working extracting lime in Colorado, Lakes noted, "[t]hey showed us some large *Inocerami* shells and expressed some interest and surprise when I told them they were working upon and digging up the bottom of an old sea and that an ocean had once been here."[135] The fossil quarries that Lakes lingered in were not solely studied by scientists and fossil hunters; they were also often frequented by lay visitors.[136] These visitors often brought misperceptions with them and were intrigued by the fossil finds. For example, Lakes met with the disbelief of local Coloradans in 1877:

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[133] Sternberg, *The Life of a Fossil Hunter*, 137-138.
[134] Those men working in the field had direct exposure to locals in the West and had opportunities to educate those who were interested in their finds. Therefore, the discussion of education in this section primarily concerns the work of fossil hunters and field workers rather than credentialed scientists. However, this does not mean that paleontologists like Cope and Marsh did not have an impact on educating the public through their scientific work or their field experiences. Yet, it may be the case that fossil hunters and field workers were better equipped to educate the everyday citizen since they were better able to relate to that population.
[135] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 21.
[136] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 19, 65, 68, 91-95.

> The news of the petrified monster had spread and an eager crowd followed the wagon to Mr. Young's empty office which had been kindly lent me as a storeroom. And many hands were ready to help in unloading…The bones were arranged on the floor of the room and a crowd as many as could be crammed into the room filled the little shanty and increased my agony tenfold by the rough way in which they handled the specimens. Many were skeptical as to their being bones at all (a skepticism we often met with afterwards) and all were astonished at the gigantic size of them speculating as to the character and magnitude of the creature whose property they were. Some after ocular demonstration had relieved them somewhat of their skepticism began to think the whole "hogback" might be the remains of some petrified monster…Occasionally one would return bringing with him a skeptical brother whom he desired to have converted.[137]

Lakes educated the eager locals about the paleo-past of the West, the plasticity of the environment, and the extinction of ancient organic forms.

Lakes was not the only man of science that people of the frontier found prospecting in their backyards. While staying at the Monument House, 20 miles north of Colorado Springs, on August 28, 1877:

> The people of the hotel told me that a certain very learned geologist had boarded there and showed me a fossil carefully wrapped up with an extensive label stating that it was a bone which had been found beneath so many thousands of feet of rock and was many millions of years old. The two latter points I did not contest but the former I did for this interesting bone proved to be nothing more than a piece of petrified wood.[138]

Using his ample knowledge of the geology and paleontology of the region, Lakes was able to correct this assessment of the specimen. The incorrect identification of this specimen indicates that even supposedly credentialed experts could be wrong and spread

[137] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 15.
[138] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 56, 175.

false knowledge to the broader educated public. This was not the only educating he did on the subject of the earth he was busy excavating. Once he returned to Morrison, CO, Lakes stated:

> I gave a couple of lectures there on the Dinosaurs to the people who had often made many inquiries about the bones and animals to which they belonged and had generally taken much interest in our work.
>
> I tried to sum up all the questions that I could remember to have been asked me and answered them to the best of my ability such as: What kind of animal was he, how long, how did he get into the rock and how did his bones become turned into stone. One old gentleman, a colonel who came out on the Omaha excursion was brought puffing up the hill to see the wonder and asked me out of breath, "Mr. Lakes I don't see how an animal seventy feet long ever climbed up this hill when I can't do it myself." I frequently had to arm who le parties of people up to the diggings and standing on the edge of the dump explain to them the history of the strata of whose development wave upon wave there was the grandest example before us. It was easy from this shot to point to the prairie and show how the strata had once been laid out flat as the seas bottom and how as we approach the mountains the uplifted edges show the upheaval of the mountains, carrying the stratified rocks up with them. Then the age at which this animal lived was asked and I could reply by pointing to the thickness of the rock above them over 300 feet every layer of which might indicate many hundreds of years and then to the vast thickness represented on the prairie of a mile or more of rock all of which lies above our Dinosaurs.[139]

Similarly, while at Como Station, on August 24, 1879, Lakes "[l]ectured in the freight room on the form[ation] of the Earth etc."[140] He also likely lectured to the many railroad workers who would regularly invade their camp and to passengers making their way

[139] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 69-70.
[140] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 134.

through along the Union Pacific Railroad.[141] By providing these educational lectures, Lakes was a minister for the malleability of the West.

J. P. Sams, while on the 1895 Kansas Expedition, also educated westerners in the ways of the West's geologic history. While in the field, he spoke to a number of settlers and train passengers about their curious finds from the fossil beds. In Lusk, Wyoming, Sams recounted the difficulties imposed by the plethora of persistent people that inquired about their fossil finds as they were packing up their finds in the railroad depot.

> It keeps the doctor and myself pretty busy explaining to the curious people the size, makeup, name and habits of our find. They swarm from the town and all passing trains…After dinner, a company of ladies with their male escort hunt me up and request me to go with them down to the depot and explain to them something about the large fossil and deliver them a short lecture on the geology of their country also the size, makeup and habits of living, brain capacity, speed and etc. of the animal…The passengers, men and women and kids swarm off to see the specimens and ask questions. The train men all know I am here with it and it seems they tell everybody on the train by the way they tumble over themselves and each other in getting off the train, and such questions (mostly by the ladies of course) as: "Oh, my do such animals as these live in this country; If so I shall go right straight back home, and would it attack a person if it were alive & how fast could it run how long has it been dead" and other similar questions rattled off by about a half a dozen at a time, too fast for a Philadelphia lawyer to digest and answer.[142]

People were interested in the fossils found by the expedition and eagerly sought information about their nature. In this railroad depot, Sams was spreading his acquired

[141] November 15, 1877; Arthur Lakes Letters and Sketches to O.C. Marsh from Morrison CO. 1877-1879; Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).
[142] *Brown and Sams, A Triceratops Hunt in Pioneer Wyoming*, 96-97, 101-103.

amateur knowledge of paleontology and the plasticity of the West to the curious masses living in the Great American Desert or passing through it on iron rails.

The paleontologist Barnum Brown also interacted with ranchers and locals in the western field. For example, the 1908 collection season in and around the Cretaceous Hell Creek Beds in Montana where he discovered a *Tyrannosaurus Rex,* and on portions of the Crow Agency, Brown referred to the area as "the Dry" and noted a number of interactions he had with the local ranchers and sheepherders.[143] Throughout his field notebook, he made note of intimate interactions and close relationships he formed with ranching families that he has visited over the years. While in the western field, Brown played with their children, ate and engaged in conversation at their dinner tables, borrowed their horses and materials, slept at their homes, engaged in frivolity and celebrated holidays such as the Fourth of July, danced with them, photographed their lives and local events, and often used their ranches to deposit fossil finds on their way back East.[144] At one point, Brown attempted to locate a skeleton that a rancher named Gruell had "discovered years ago."[145] Some ranchers even visited their diggings and in one instance Brown noted, "[w]e went over to the quarry and they saw the excavation and a few bones enough to satisfy their curiosity," On a different day, he noted, "[w]e walked over to quarries and they were much impressed with big dinosaur. Afterwards, I took them over the hills collecting."[146] It is apparent that they were curious about the fossils and assisted with Brown's collecting. Guided by Brown, holding these relics from the

[143] Brown, "Field Book: Barnum Brown 1908: Hell Creek Beds - Montana."
[144] Brown, "Field Book: Barnum Brown 1908: Hell Creek Beds - Montana."
[145] Brown, "Field Book: Barnum Brown 1908: Hell Creek Beds - Montana."
[146] Brown, "Field Book: Barnum Brown 1908: Hell Creek Beds - Montana."

deep past may have enabled these visitors to travel through time and see the impermanence of their western environment.

Doctors, missionaries, traders, pioneers, judges, railroad engineers and western settlers and travelers experienced fossil remains while they were immersed in the West's environment. They could not ignore its character as they pondered the meaning of these objects. A large number of nineteenth-century Americans were intrigued by these curiosities and were willing to help scientists collect them from the earth. They were willing not only to offer up parts of their personal collections, but also to lend their physical strength to the hard work of extracting fossils from their rocky substrate. Those men knowledgeable in the ways of the earth sciences were willing to educate interested Americans about the nature of fossils. Through these interactions, the gospel of the plastic West spread throughout the region.

Bridging Worlds through an Exceptional Example: The Cook Ranch, Fossil Knowledge, and Native Americans

No doubt, of course, many settlers cared nothing about petrified pieces of the past. Yet, a surprising number of settlers took an active interest in paleontology. For example, as the West became increasingly populated in the late nineteenth century, ranchers and their ranches played a significant role in the development of American paleontology. Many ranchers were aware of the fossil wealth that lay beneath their feet and helped paleontologists in their quests to find fossils. James Cook's life bridges the worlds discussed in this chapter. Cook wrote an autobiography that was published in 1923 titled

Fifty Years on the Old Frontier, as Cowboy, Hunter, Guide, Scout, and Ranchman, which serves as the centerpiece of this section.

As a frontier guide he formed lifetime friendships with Native Americans and was aware of their fossil legends, and as a rancher/property owner with fossil wealth on his land he collaborated with eastern paleontologists in the acquisition of specimens.[147] He was the great-grandson of the explorer Captain James Cook and had worked as an outfitter for hunting parties in Wyoming, as a hunter for the Union Pacific Railroad, a guide for U.S. troops fighting the Apache War against Geronimo, a scout for General Miles, and according to Cook worked with Yale paleontologist Marsh "in getting permission from the Sioux Indians in Dakota Territory to collect in the Badlands."[148] In 1874, Cook used his friendship with the Sioux Chief Red Cloud to convince him that Marsh was in fact not looking for gold and would be a good ally in Washington.[149]

In Cook's early years in the West his employment was quite variable. Like so many of the men of the frontier that stood on the cusp of the settling West, Cook was able to escape elements of its "civilizing" influence but take advantages of the gifts and employment opportunities of industrial society. According to Cook, Marsh also employed "Mr. H. Clifford, a government scout and interpreter of the Sioux language, [and]

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[147] Jeremey Vetter's work on the Cook family is a great study of how the Cook family navigated its relationship with the scientific establishment and were in a sense scientific collaborators.: Jeremy Vetter, "Cowboys, Scientists, and Fossils: The Field Site and Local Collaboration in the American West," *Isis*, Vol. 99, (2008), 273.

[148] Vetter, "Cowboys, Scientists, and Fossils…," 282.; James H. Cook, *Fifty Years on the Old Frontier, as Cowboy, Hunter, Guide, Scout, and Ranchman* (New Haven, CT: Yale University Press, 1923).; "Harold J. Cook, Noted Sioux County Resident, Dies Saturday," *The Lusk Herald*, October, 4 1962. http://www.niobraracountylibrary.org/obituaries/?id=874.; Erwin B. Barbour, "James Henry Cook," in Albert Watkins, ed. *History of Nebraska: From the Earliest Explorations to the Present Time with Portraits, Maps, and Tables* Vol. III (Lincoln, NE: Western Publishing and Engraving Company, 1913), 477-482.

[149] Cook, *Fifty Years on the Old Frontier*, 227-228.; Osborn, *The Titanotheres of Ancient Wyoming, Dakota, and Nebraska*, Vol. 1, xxi-xxii.

collected fossils on the Niobrara River east of this point some time before the fossils were taken from the hills of Agate."[150] As a "so-called squaw man" "of almost unparalleled profanity" and the husband of Red Cloud's daughter, it is likely that Clifford was aware of the Native American knowledge of fossils in the vicinity and thereby assisted Marsh in locating the buried treasures of the Niobrara.[151] Clifford was among the many frontiersmen that Marsh called upon for their knowledge of the western landscape and peoples.[152]

Similarly, Cook negotiated permission between the Sioux and Marsh and tracked down fossil knowledge from Native Americans to give to Marsh.[153] But he is best known for his association with the Agate Fossil Beds in Nebraska. The National Park Service now controls these rich fossil beds and acknowledges on the home page for Agate Fossil Beds National Monument, "[d]uring the 1890s, scientists rediscovered what the Lakota Sioux already knew – bones preserved in one of the most complete Miocene mammal sites in the world."[154] Cook's own discovery of the fossils of Agate Springs came when he was "[r]iding one day along the picturesque buttes which skirt the beautiful valley of the Niobrara" with his soon-to-be wife.[155] While climbing some hills about three miles outside of his soon-to-be father-in-law's ranch, they came across some curious remains.

> About halfway to the summit we noticed many fragments of bones scattered about on the ground. I at once concluded

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[150] Cook, *Fifty Years on the Old Frontier*, 277.
[151] Thomson, *The Legacy of the Mastodon*, 244, 266.; Othniel Charles Marsh, Pocket Notebook 7, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).
[152] Thomson, *The Legacy of the Mastodon*, 246.
[153] Mayor, *Fossil Legends of the First Americans*, 240-241.; Cook, *Fifty Years on the Old Frontier*, 227.
[154] National Park Service, "Agate Fossil Beds National Monument," accessed May 27, 2014, http://www.nps.gov/agfo/index.htm.
[155] Cook, *Fifty Years on the Old Frontier*, 274.

> that at some period, perhaps years back, an Indian brave had been laid to his last long rest under one of the shelving rocks near the summit of the hill, and that, as was the custom among some tribes of Indians at one time, a number of his ponies had been killed near his body. Happening to notice a peculiar glitter on one of the bone fragments, I picked it up; and I then discovered that it was a beautifully petrified piece of the shaft of some creature's leg bone. The marrow cavity was filled with tiny calcite crystals, enough of which were exposed to cause the glitter which had attracted my attention. Upon our return to the ranch we carried with us what was doubtless the first fossil material ever secured from what are now known to men of science as the Agate Springs Fossil Quarries.[156]

After describing his discovery in his memoir, Cook then listed the many institutions that sent scientists to what was to become his ranch. The importance of the railroads and good transportation networks in the study of these fossils did not escape Cook's attention. "Now that railroads, towns, and good motor roads have penetrated to the region of these oldest and most truthful records of the misty past," according to Cook, "many persons from various parts of the world journey each season to see the place in which they have been preserved for unknown millions of years."[157] Not only were the visitors to Agate Springs geographically diverse, but Cook informed his reader that the site not only attracted "our scholars in science," but "even theology."[158]

To be sure, Cook himself was an educated observer of the remains that dotted his ranch. As a cowboy, rancher, friend to Native Americans, and hunting guide, Cook would have been quite familiar with Native American burial sites and the many species of

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[156] Cook, *Fifty Years on the Old Frontier*, 274.; See also news accounts that document stories of his discovery: "Visited Agate Fossil Beds," *The Alliance Herald*, July 19, 1917.; "Nebraska Fossils Famous," *San Francisco Chronicle*, June 4, 1919.
[157] Cook, *Fifty Years on the Old Frontier*, 275.
[158] Cook, *Fifty Years on the Old Frontier*, 275.

animal bones that dotted the western landscape. Cook was intimately connected to the natural world through his work. [159] "Being a student of nature," Cook had faith that he was capable of identifying what was and was not a fossil.[160] In his memoir, Cook stated, "[d]uring the time I had been in Wyoming and Colorado, I had met on numerous occasions Professors E.D. Cope and O.C. Marsh," both of whom he assisted in the field.[161] During this time, Cook explained, "[m]y two partners were greatly interested in all things pertaining to natural history. We were all close observers of everything animate or inanimate, pertaining to any section of the country in which we ever ranged."[162] Cook admitted, "[t]he evidence of anything connected with prehistoric animal or plant life was especially interesting to me."[163] His exposure to these two infamous paleontologists provoked his "desire to know more about such things" and he "was always on the lookout for any fossil material which I might find exposed, in order that I might direct it to men who made a special study of such material."[164] Cook's interest in the fossilized remains of the deep past came with a deference to higher authorities of knowledge in interpreting the specimens he located in the western field. However, he had an amateur's knowledge that was sufficient enough to identify specimens worthy of consideration and he knew that Native Americans had knowledge worth considering in finding these mysterious relics.

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[159] As environmental historian Richard White stated, "[w]ork once bore the burden of connecting us with nature.": Richard White, "'Are You an Environmentalist or Do You Work for a Living?': Work and Nature," in William Cronon ed., *Uncommon Ground : Toward Reinventing Nature* (New York: W.W. Norton & Co., 1995), 174.; Richard White, *The Organic Machine* (New York: Hill and Wang, 1995).
[160] Vetter, "Cowboys, Scientists, and Fossils…," 286, 290.
[161] Cook, *Fifty Years on the Old Frontier*, 133.
[162] Cook, *Fifty Years on the Old Frontier*, 133.
[163] Cook, *Fifty Years on the Old Frontier*, 133.
[164] Cook, *Fifty Years on the Old Frontier*, 133.

Cook's participation in paleontology and frontier life, by at least 1923, made him well aware of the plasticity of his home. His visions of plasticity encompassed the changes that took place many millions of years ago to those that occupied his lifetime in the West. "Having been a western man," Cook commented, "I could not but take intense interest in the changes that have come into my little world."[165] With this statement, Cook primarily meant the destruction of the local wildlife and the subjugation of the Native Americans of the West. The preface of his memoir *Fifty Years on the Old Frontier*, written by Charles King of the U. S. Army's Fifth Cavalry, began by narrating the work of James Cook in reclaiming the desert that once covered where his verdant ranch now stands. Coming upon Cook's land after a long absence in the region, King pondered:

> Where were the broad levels, barren save for the gray-green bunch grass that bordered either bank? Vanished. And in their stead, uplifted before our eyes, there stood a bowery oasis in the very center of what once had seemed a shadeless desert – a vision of leafy shelter, of flowering shrubs and plants nestling under the foliage of dense groups of graceful trees, with trim hedgerows and trellised vines, bordering here, there, and everywhere sparkling runlets of clear, cool water; and in their midst, glistening white in the morning sunshine, with its columned portico and spreading verandas, green-shuttered windows and peaked roofs, a commodious modern homestead…And it was Captain Jim who had tamed this wilderness, taught it to blossom like the rose, and, after over thirty years of herding, hunting, scouting, and trailing, from Mexico to Montana, had settled in the heart of what had been the Sioux country, in the midst of the country that now bears the name of that famous nation, and built him a little world of his own where once there grew not so much as the splinter of a lodge-pole.[166]

[165] Cook, *Fifty Years on the Old Frontier*, 281.
[166] Cook, *Fifty Years on the Old Frontier*, xiv-xv.

In the eyes of King, Cook had reclaimed this desert and made it an oasis. Cook had wrought changes in the land and demonstrated its plasticity. As will be discussed in Chapters 7 and 8, the sentiments expressed above were not uncommon during the late nineteenth and early twentieth centuries. Embodying the dreams of western settlement, Cook had turned the desert-West into a "modern" homesteading paradise.

Cook and his progeny also held a distinct fascination for the changes wrought over geologic time. Cook knew enough about the science to present his reader with the following description of the paleo-environment occupied by the now fossilized fauna surrounding his ranch. In the style of the survey scientists of Chapter 4, Cook envisioned the past.

> Unquestionable evidence shows that, back in the Oligocene and early Miocene times, the country about Agate somewhat resembled the country at the mouth of the Amazon River to-day – a great flood plain. The animal life which inhabited the country in that age was sometimes entrapped on the higher grounds by sudden floods which caused all mammalian life to rush to the elevations for safety.[167]

Cook's imagination was able to travel to the distant past to see the location of his ranch as an ancient floodplain that shared characteristics with the tropical environs of the Amazon River [Figure 41]. Through his exposure to fossils, Cook became familiar with the plasticity of the natural world at the same time that he was personally experiencing the tremendous changes enacted around him through the industrialization of the American West.

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[167] Cook, *Fifty Years on the Old Frontier*, 276, 278.

Scientists were not the only people to visit the ranch. Cook took his friends to the sites to collect these curiosities from the hillside.[168] Cook also stated, "many who have no knowledge whatever of fossils visit the ranch to satisfy their curiosity as to what the noise is all about."[169] Inevitably these curious minds came with palettes of ideas that colored how they interpreted the fossilized remains of the deep past. "Some come," according to Cook, "loaded on the subjects of Darwinism and evolution, who have perhaps secured their knowledge on such subjects from sources of little value."[170] Cook followed this statement with a very insightful comment into mental inhibitions to which he presumably was immune. With geological flourish, Cook regretted "[p]ounding on the rock of truth with hammers of preconceived notions and prejudices is a hard and fruitless task, even when attempted by men who have accomplished great things in other provinces of study."[171]

Fossils can yield convincing evidence for a great many things. Humans come to the hard material of fossils with sets of beliefs that add colors and shades to how the fossils are incorporated into the past, present, and future of their world. For example, Cook's experience revealed visions at odds with his own and inflected with religious cosmology:

> One gentleman who visited my home introduced himself as a Mormon elder. He accounted for the great mass of petrified bones found there by saying that "Noah might have heaved a lot of dead animals off the ark when floating over their burial place." Another visitor at Agate – a circuit

[168] Jeremy Vetter, "Science Along the Railroad: Expanding Field Work in the Us Central West," *Annals of Science* 61, no. 2 (2004): 285.
[169] Cook, *Fifty Years on the Old Frontier*, 278.
[170] Cook, *Fifty Years on the Old Frontier*, 278.
[171] Cook, *Fifty Years on the Old Frontier*, 278.

> rider, who was making the rounds of the small settlements in northwestern Nebraska, preaching to the early settlers – informed us that those petrified bones were toys of the devil, placed there in the rocks by the devil himself to deceive people and upset the Bible story of the creation…Clergymen of many denominations come to study the records in the rocks; also professional men in many departments of study. Such men are deeply interested, as a rule, in searching for the truthful answer to the questions, Did, or did not, mankind evolve from a lower form of animal life into its present state of mental and physical development? and Does the Bible story of the creation of the world and of mankind, as usually interpreted by Bible teachers, ring more true than do the stories told in the records which have been kept in the rocks of the world since the time when living beings of any sort must surely, to make a success of living, have been veritable fire and gas eaters? These questions at the present time are being discussed in the pulpits of our country more than ever before. Evolution seems still to be, to many people, "one grand fish story."[172]

Cook dismissed these religious interpretations and admitted his allegiance to "those who dig and scrape out of the rocks the tangible evidences on this subject" and stated, "Sioux County, Nebraska, is most interesting to those who seek for knowledge of the origin and evolution of the plant and animal life of the world. Exposures of several of the geologic periods in the earth's history can there be found, and the stories of life of those periods unearthed."[173] Indeed, the Agate Springs Ranch fossil beds have contributed valuable knowledge to the evolution of mammals.[174] Cooks mind was flexible to the developments of science and the rapid changes inherent in the search for knowledge. He stated, "[o]f course, I might have to abandon them at any time; for each hour in the life of to-day

[172] Cook, *Fifty Years on the Old Frontier*, 278, 280.
[173] Cook, *Fifty Years on the Old Frontier*, 279, 280.
[174] Vetter, "Cowboys, Scientists, and Fossils…," 292.

seems to add in many fields to the accumulated knowledge of mankind."[175] His life bridged two centuries fueled by fossilized remains that rapidly industrialized the West and advanced American science. Subjected to the instability inherent in these massive changes in the nature and pace of everyday life, Cook was conditioned to a healthy degree of skepticism.[176]

As a friend of the Sioux, Cook was already a man of at least two worlds when he came across his fossil finds. That Cook befriended Native Americans in a West that was often hostile to their very existence reveals that he was open to alternative visions of the world. While he fought in battles against the tribes of the West, he was not a myopic man motivated solely by Manifest Destiny and blinded by racist categories of civilization. Cook's 1887 purchase of what he would call "Agate Springs Ranch" in western Nebraska from his father-in-law saw the land become a melting pot and meeting place of cultures. Being a friend to the local Native Americans, Cook invited his Sioux friends to visit his ranch each summer and use the land that they once controlled.[177] The National Park Service's history of Agate Fossil Beds National Monument states:

> During this time of scientific exploration other gatherings took place at the Agate Springs Ranch. Red Cloud of the Oglala Lakota Sioux and many of his friends and family members would make the 150 mile trip by wagon from the Pine Ridge Reservation. While staying at the ranch they hunted, worked for James Cook, and butchered beef they were given, tanned hides, told stories and danced. Many residents of the surrounding area remember going to the

[175] Cook, *Fifty Years on the Old Frontier*, 280.
[176] Cook's education is not clear from the available records. It appears that he was self-educated as he absorbed a significant amount of education in the course of his varied life. It is possible that he may have been assisted in writing his autobiography by his college-educated son Harold.
[177] Mayor, *Fossil Legends of the First Americans*, 241-244.

> ranch to watch and participate in the dancing and singing.[178]

The intimate encounters described above do not directly reveal anything about fossil knowledge. However, since Cook's ranch was a Mecca for paleontological prospecting, conversations concerning fossils were a part of this revelry and as the visitors hunted and worked for Cook they could very well have helped to excavate or locate ancient remains.

In the media, Cook was known for his fossil finds and his friendship with famous Native Americans. A picture of the famous Red Cloud was featured in the April 8, 1904, edition of *The Alliance Herald*, in an article titled "Red Cloud: The Famous Chief's Plea for Justice" and "[a]t the time it was taken [1900] this noted Indian was the guest of Captain 'Jim' Cook and wife, to whom he pays a visit each succeeding spring."[179] In 1917, a local Nebraska newspaper noted:

> At the Cook ranch home the visitor may feast his eye on the best collections of Indian relics and prehistoric fossils that there are in the state and we go further in saying that there would be few collections in the world that would equal, let alone surpass them. Captain Cook during his time in the west, has devoted his spare time to a study of the Indian and his knowledge is far and wide in relation to the red man. Here at his ranch such noted chiefs as Red Cloud, American Horse and Jack Red Cloud have spent many summers. They look upon Captain Cook as a good true friend and their presents to him in the shape of beaded work and other work have been many and beautiful. No one could ask for more profitable half day's time than going through his collection. And the gracious manner in which he displays his prize relics to the visitor cannot help but make one feel that here is a man who has lived to better the welfare of mankind.[180]

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[178] National Park Service, "Agate Fossil Beds: History & Culture," accessed May 27, 2014. http://www.nps.gov/agfo/historyculture/index.htm.
[179] "Red Cloud: The Famous Chief's Plea for Justice," *The Alliance Herald*, April 8, 1904.
[180] "Visited Agate Fossil Beds."

Cook's fossil finds and friendship with Native Americans turned his house into a museum filled with specimens sought by science and ogled by visitors [Figure 42]. With the wealth of specimens hanging from its walls, his home was in essence a giant cabinet of curiosity.[181] He was a man of a previous time when holding on such specimens and displaying them was in vogue. The turn of the century brought changes in tastes for home décor that pushed the cabinet of curiosity out of the home and towards intuitions of learning.[182] The view that valuable scientific specimens sitting in private cabinets of curiosity should instead be placed in the hands of credentialed men of science and employed in the service of education began to gain traction in Antebellum America.[183] To hold on to a private collection of fossils was increasingly viewed as selfish and not in the interest of science or the nation.[184]

Cook lived an exceptional frontier life that was set comfortably in a liminal zone between cultures of science and ethnicity. Involved in almost every facet of frontier life, he sat at the nexus of knowledge and experience in the American West. Friend to both Native Americans and paleontologists, he was familiar with how fossil knowledge could be put to use and set within a cosmological framework. He also invited interested members of the public to inspect the fossils on his ranch and he heard their opinions

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[181] A fold-out picture of Cook's ranch den clearly illustrates this point.: Cook, *Fifty Years on the Old Frontier*, 280-281.
[182] Mark V. Barrow, "The Specimen Dealer: Entrepreneurial Natural History in America's Gilded Age," *Journal of the History of Biology* 33, no. 3 (2000): 523.
[183] Sally Gregory Kohlstedt, "Curiosities and Cabinets: Natural History Museums and Education on the Antebellum Campus," *Isis* 79, no. 3 (1988): 405-426.
[184] For example, an 1882 news article concerning the National Museum in Washington D.C., stated that there was enormous value in the rare paleontological specimens America possessed and that the museum was a secure place to contribute private collections of specimens for the benefit of educating the public.: "National Public Museum," *New York Times*, February 19, 1882.

about the nature and meaning of the remains. As a rancher, he was also involved in the practice of reclaiming the West from its arid character. Cook's West was a rapidly changing and cosmopolitan region that demonstrated its fluidity through fossils, science, cultural exchange, and expanding transportation networks.

Conclusion

This chapter illustrates that the material nature of fossils found in the West spoke of a malleable world across cultures. Native Americans often regarded fossils as sacred and as an indication of a cyclical understanding of time and environmental change. Fossils were not inert matter, but rather radiated with sacred purpose that was to be respected and at times feared. The following chapters will focus on how Euro-Americans incorporated these fossils into their national framework and worldview. Fossils and western expansion directly related to the Euro-American relationship to time.[185] Inspired by the Bible and industrialization the forward march of progress was the dominant narrative of western science and society.[186] Faith in progress, emboldened in part by the transformative capacity of so-called "fossil fuels" and industrialization, colored the ways in which these mineralized artifacts fit into Euro-American cosmology.[187] Cycles did enter into this story, but in terms of the environment these recurrent phases of

[185] Stephen Jay Gould, *Time's Arrow, Time's Cycle: Myth and Metaphor in the Discovery of Geological Time* (Cambridge, MA: Harvard University Press, 1987), 137.
[186] Gould, *Time's Arrow, Time's Cycle*, 12.
[187] The term "fossil fuel," according to the Oxford English Dictionary (OED), has its origins in the late eighteenth century. The word "fossil" initially meant something that was found below ground, only later was the word "fossil" as it was paired with "fuel" associated with its ancient character. The OED, however, does not provide a date for when that transition occurred. Furthermore, both definitions of "fossil" seem to occur near simultaneously in the late seventeenth century. It is therefore likely that the fossil character (its origins as old organic matter) was known at least by the late eighteenth century. "fossil fuel, n.". OED Online. December 2014. Oxford University Press. http://www.oed.com/view/Entry/274339 (accessed March 03, 2015).

regeneration and reclamation from the Fallen wilderness to an Edenic garden were what geographer Yi Fu Tuan referred to as "waves in the directional stream."[188] Industrialization and the expanding transportation frontier in the West upset a nature-inspired cyclical view of time. With the help of the transcontinental railroads, Euro-Americans were in the midst of a large migration across the North American continent facilitated by industrialization and fossil fuels. The long-distance travel into the horizon and the power of industrialization disrupted a cyclical view of time and yielded a supranatural progress perspective.

Fossils were powerful objects for Native Americans as well as American paleontologists. Native Americans recognized the power inherent in these remains and used them as *medicine* to wield control over crucial aspects of their lives such as the arrival of buffalo. Paleontologists recognized that fossils were natural resources that granted them the power of scientific priority which could lead to patronage from a wealthy benefactor.[189] Museums recognized their power to draw visitors and coveted these specimens.[190] As will be demonstrated in the following chapter, fossils could also

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[188] Yi-Fu Tuan, *Topophilia: A Study of Environmental Perception, Attitudes, and Values* (New York: Columbia University Press, 1990), 148-49.; For a discussion of cycles as they are represented in a variety of cultural perspectives, see also: Mircea Eliade, *Cosmos and History: The Myth of the Eternal Return* (New York: Harper & Brothers, 1959).

[189] Lukas Benjamin Rieppel, "Dinosaurs: Assembling an Icon of Science" (PhD diss., Boston, MA: Harvard University, 2012).

[190] Paul D. Brinkman, *The Second Jurassic Dinosaur Rush: Museums and Paleontology in America at the Turn of the Twentieth Century* (Chicago, IL: University of Chicago Press, 2010).; John McIntosh, "The Second Jurassic Dinosaur Rush," *Earth Sciences History* 9, no. 1 (01/01/ 1990): 22-27.; Douglas J. Preston, *Dinosaurs in the Attic: An Excursion into the American Museum of Natural History* (New York: St. Martin's Press, 1986).; Ronald Rainger, *An Agenda for Antiquity: Henry Fairfield Osborn & Vertebrate Paleontology at the American Museum of Natural History, 1890-1935* (Tuscaloosa, AL: University of Alabama Press, 1991).; Lukas Rieppel, "Bringing Dinosaurs Back to Life: Exhibiting Prehistory at the American Museum of Natural History," *Isis* 103, no. 3 (2012): 460-490.

provide monetary profit to those who mine them from the earth. Lastly, fossils could work as powerful scientific capital to advertise for future of the West through its past.

This chapter also demonstrates that the value of amateur collection of fossils in the western field should not be overlooked. The industrialization of the West on iron rails brought more and more people interested in natural history into the arid stretches that held fossilized treasures for the keen observer. Excitement about finding fossils was the province of professional scientists and fossil hunters and lay and amateur collectors, all vital collaborators in producing scientific knowledge from the nature of the western field. The spread of knowledge of the malleable West occurred through physical contact with the remains of former paleo-environments. Touching evidence of a watery and verdant past and seeing evidence of monstrous creatures made people think seriously about the fluidity of the landscape. Collectively, the efforts of scientists and westerners added to public interest in and knowledge of the plasticity of the West.



Figure 33. Titian Ramsay Peale “Western Engineer” (1820). Source: Titian Ramsay Peale, “Engineer Cantonment [Missouri River],” Mss.B.P31.15d, Titian Ramsay Peale Sketches, American Philosophical Society, accessed January 14, 2015. http://diglib.amphilsoc.org/islandora/object/graphics:63.



Figure 34. Titanotheres Frontispiece. Source: Henry Fairfield Osborn, *The Titanotheres of Ancient Wyoming, Dakota, and Nebraska*, Vol. 1, U.S. Geographical Survey. Monograph (Washington,: U.S. Govt. print. off., 1929).



Figure 35. Titanothere Skeleton. Source: Henry Fairfield Osborn, *The Titanotheres of Ancient Wyoming, Dakota, and Nebraska*, Vol. 1, U.S. Geographical Survey. Monograph (Washington,: U.S. Govt. print. off., 1929), 702.

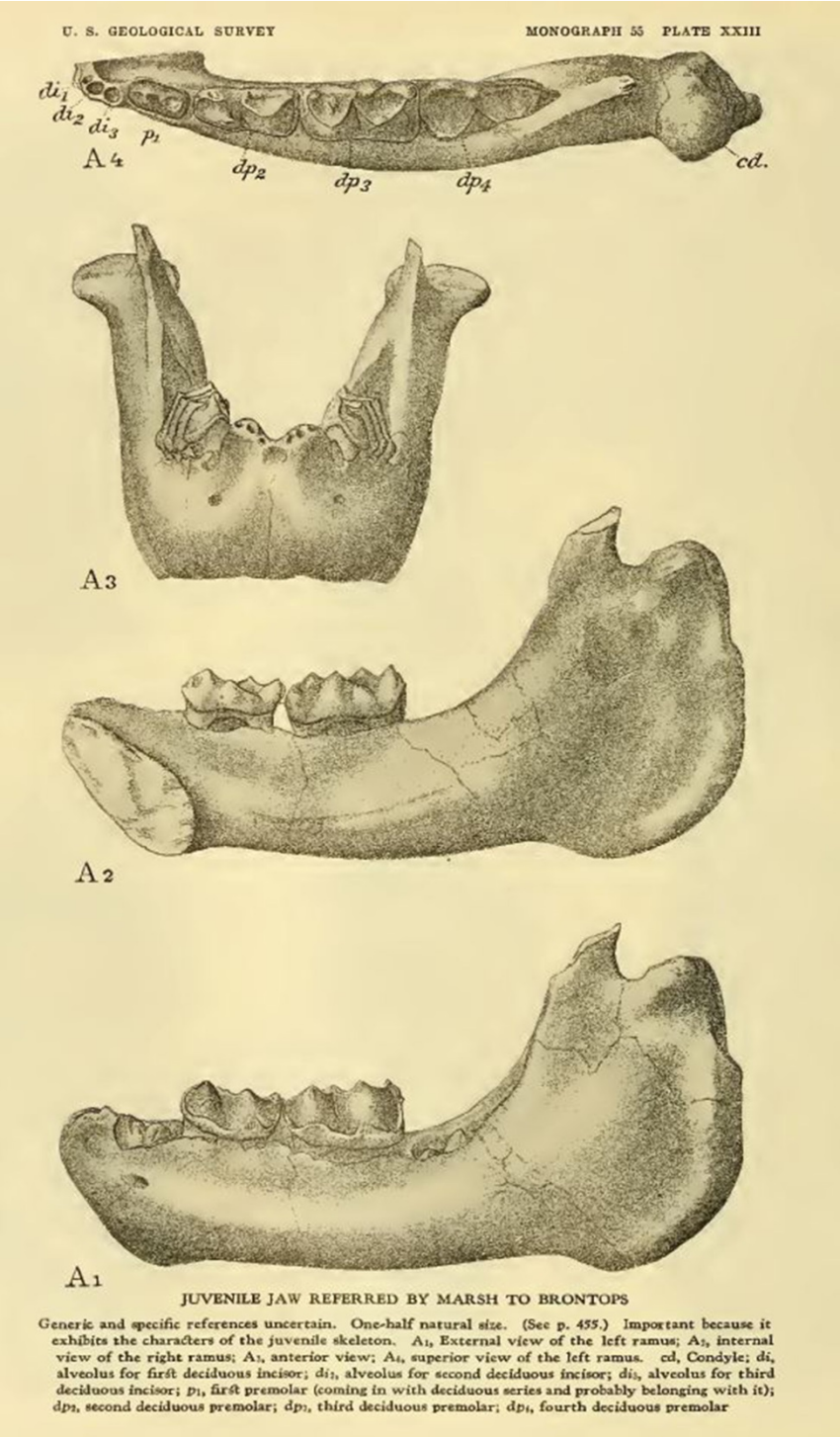


Figure 36. Titanothere Jaws and Teeth. Source: Henry Fairfield Osborn, *The Titanotheres of Ancient Wyoming, Dakota, and Nebraska*, Vol. 1, U.S. Geographical Survey. Monograph (Washington,: U.S. Govt. print. off., 1929), 582.



Figure 37. Belemnites. Source: Public Domain.



Figure 38. Ammonite. Source: Wikimedia Commons, “Photograph of a fossil ammonite Jeletzkytes spedeni taken by Dlloyd. The specimen is from the Maastrichtian (Upper-Cretaceous) Fox Hills Formation. Locality - South Dakota, USA. Matrix free specimen, 7.5 cm (3") in diameter, displaying pearly aragonite preservation of the shell,” accessed March 18, 2015. http://commons.wikimedia.org/wiki/File:Ammonite_Jeletzkytes.jpg.



Figure 39. Baculite. Source: Wikimedia Commons, “Baculites from my collection; pic taken by me on 3/13/05. They are pyritized to a large extent. Some also show traces of the original nacre (aragonite; mother-of-pearl) shells. Baculites are a kind of ammonite. These come from the Pierre Seaway strata of South Dakota, USA. They are internal molds, and the suture lines of the internal septa can be seen,” accessed March 18, 2015. http://commons.wikimedia.org/wiki/File:SouthDakotaBaculites.jpg.



Figure 40. Exhumation of the Mastodon (1806). Source: Charles Willson Peale. Public Domain.



Figure 41. Agate Springs Fossils (1935). Source: “Three ton slab of Harrison sandstone with inbeded fossils taken from Agate Springs, ca. 1935,” National Archives, Online Public Access, Record Group 79, Records of the National Park Service, accessed March 20, 2015. http://research.archives.gov/description/286049.



A glimpse of Captain James H. Cook's den in the ranch house at Agate, Nebraska.

Figure 42. Cook's House. Source: James H. Cook, *Fifty Years on the Old Frontier, as Cowboy, Hunter, Guide, Scout, and Ranchman* (New Haven, CT: Yale University Press, 1923), 280.

FINDING PROFIT IN THE PUBLIC'S FASCINATION WITH FOSSILS: THE MEDIA, PEDDLING CURIOS, RAILROADS, AND BOOSTING THE WEST THROUGH ITS GEOLOGIC HISTORY

> This region, which resembles one of the immeasurable steppes of Asia, has not inaptly been termed "the great American desert." It spreads forth into undulating and treeless plains, and desolate sandy wastes, wearisome to the eye from their extent and monotony, and which are supposed to by geologists, to have formed the ancient floor of the ocean, countless ages since, when its primeval waves beat against the granite bases of the Rocky mountains.[1]
> ~Washington Irving, *Astoria*, 1836

The Great American Desert entered into contemporary literature along with the region's geologic history.[2] Its watery past flowed from scientific reports into the public sphere. Irving's *Astoria* contained the above passage that directly referenced the Great American Desert and its geologic past. Using the science of his day he entered into a geological discussion that directly juxtaposed the desert realm to a watery former world. Irving's reference to the ancient oceans of the West was likely derived from the published account of Long's expedition.[3] In *Astoria*, Irving described the nature of the Great American Desert and informed his readers that "[i]t is a region that almost discourages all hope of cultivation."[4] He feared for this region's future as he believed "a great part of it will form a lawless interval between the abodes of civilized man, like the wastes of the ocean or the deserts of Arabia." Calling upon geology as metaphor, Irving stated, "[h]ere

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[1] Washington Irving, *Astoria; or, Enterprise Beyond the Rocky Mountains*, 3 vols., vol. II (London: Richard Bentley, 1836), 56.
[2] The idea of the Great American Desert is examined in detail in Chapters 1 and 7.
[3] Washington Irving, *Astoria, Or, Anecdotes of an Enterprise Beyond the Rocky Mountains*, ed. Richard Dilworth Rust (Lincoln, NE: University of Nebraska Press, 1982), xxiv-xxvi.
[4] Irving, *Astoria; or, Enterprise Beyond the Rocky Mountains*, II, 114.

may spring up new and mongrel races, like new formations in geology" as "civilized and savage" peoples and those in between intermingle in the wastes.[5]

The geology of the West and its paleontological resources were of deep interest to the public. This chapter traces the extent to which interest in the remains of geologic history spread in the nineteenth century and how this interest was put to use for varied purposes. The public worked to make sense of fossil remains found in the West and enterprising individuals took advantage of interest in these curious relics and fed fossils into a national market. The railroad is once again a character in this story as a partner in spreading fossil knowledge, in providing inadvertent access to fossil finds and geologic knowledge, and in adapting western geology to advertising ends. The Green River railroad cut is also a thread that connects the sections below. It provides a window into how different segments of society valued and understood fossils. Lastly, we see here how boosters begin to use the West's geologic history to bolster its future as America's promised land.

Popular Culture Co-opts the Ancient West: North America's Geology as the Cause of the Great American Desert *and* the Garden-West

Geology could be put to many uses. It was useful in understanding the physical and biological history of the planet and of use for mining, but what may be surprising is that geology was also useful for those writing popular tracts that dealt with the past and future of the West. Writers in the nineteenth century used the geologic history of North America for their own ends and mustered it as scientific support for their worldview. In

[5] Irving, *Astoria; or, Enterprise Beyond the Rocky Mountains*, II, 58.

the works of James Fennimore Cooper and William Gilpin we can see two opposing visions constructed using geology that represented their respective cultural moment. In their works, America's hopes and anxieties have their basis in the earth.

James Fennimore Cooper wrote *The Prairie* in 1827 when the Great American Desert swept like a sandstorm into the American imagination obscuring the Jeffersonian hopes for a garden. The success of this work ensured that it would be reprinted for audiences well into the future when the sands had settled and the garden returned to the West. With the fabulous tales of his protagonist Leatherstocking, Cooper had essentially invented the genre of the Western.[6] The introduction to *The Prairie* served to set the stage for Cooper's western drama. Writing from Paris, like Irving he relied on the published accounts of Lewis and Clark and James' account of the Long Expedition in order to construct an accurate stage for his protagonists in an environment that he had never visited.[7] The geology and deep history of the West featured prominently in the introduction.[8] Cooper began by educating his audience about the natural history of the West because the natural world was a crucial character in this tale.[9]

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[6] Henry Nash Smith, "Consciousness and Social Order: The Theme of Transcendence in the Leatherstocking Tales," *Western American Literature* 5, no. Fall (1970): 180.

[7] William W. Bevis, "The Prairie: Cooper's Desert Ecology," *Environmental Review: ER* 10, no. 1 (1986): 3-5.; James Fenimore Cooper, *The Prairie: A Tale* (New York: Hurd and Houghton, 1877), xii.; William H. Goetzmann, *New Lands, New Men: America and the Second Great Age of Discovery* (New York, NY: Penguin Books, 1987), 124.; William H. Goetzmann, "James Fenimore Cooper: The Prairie," in *Landmarks of American Writing*, ed. Hennig Cohen (New York: Basic Books, 1969).; E. Soteris Muszynska-Wallace, "The Sources of the Prairie," *American Literature* 21, no. 2 (1949).; William L. Vance, "'Man and Beast': The Meaning of Cooper's the Prairie," *PMLA* 89, no. 2 (1974): 323-331.; The 1877 version has been used in this dissertation because it illustrates that this work persisted over time and that it represented the changing times from when the desert was a barrier to movement West, to when the West was once again a garden.

[8] This information was not present in the 1827 edition. It was added in 1832.

[9] For more information on James Fenimore Cooper and The Prairie, see: Robert Clark, *James Fenimore Cooper: New Critical Essays* (London: Vision, 1985).; Wayne Fields, *James Fennimore Cooper, a Collection of Critical Essays* (Englewood Cliffs, NJ: Prentice-Hall, 1979).; Wayne Franklin, *James*

"The geological formation of that portion of the American Union which lies between the Alleghanies and the Rocky Mountains," explained Cooper in the opening sentence of *The Prairie*, "has given rise to many ingenious theories."[10] For example, the second paragraph began, "[t]here is much reason to believe that the territory which now composes Ohio, Illinois, Indiana, Michigan, and a large portion of the country west of the Mississippi, lay formerly under water."[11] Then came an "irruption that laid bare the land" and left a large portion of the country to "resemble the steppes of Tartary more than any other known portion of the world; being, in fact, a vast country, incapable of sustaining a dense population."[12] Sparse in vegetation, the arid western environment had laid open the pages of geologic time and revealed to many the ancient character of the New World. Cooper conceded that much of the land in America was fertile, but in the middle of the country there lay a "broad belt of comparative desert, which is the scene of this tale, appearing to interpose a barrier to the progress of the American people westward."[13] It was providential that the West was a desert waste since Cooper feared that the fragile social order of the Union would be forever torn asunder as a result of the rapid stretching of America's population over the vast expanse of North America.[14] The desert-West was

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Fenimore Cooper: The Early Years (New Haven: Yale University Press, 2007).; Orm Overland, *James Fenimore Cooper's the Prairie: The Making and Meaning of an American Classic* (New York: Humanities Press, 1973).; Henry Nash Smith, "Introduction," to *The Prairie* (New York: Rinehart, 1950), v-xx.; Robert Ernest Spiller, *Fenimore Cooper, Critic of His Times* (New York: Russell & Russell, 1963).

[10] Cooper, *The Prairie*, v.

[11] Cooper, *The Prairie*, v.

[12] Cooper, *The Prairie*, v-vi.

[13] Cooper, *The Prairie*, vi-vii.

[14] Overland, *James Fenimore Cooper's the Prairie*, 148-149.; This tended to be a view characteristic of residents of the Northeastern United States. Martyn J. Bowden, "The Great American Desert and the American Frontier, 1800-1882: Popular Images of the Plains," in Tamara K. Hareven, *Anonymous Americans; Explorations in Nineteenth-Century Social History* (Englewood Cliffs, NJ: Prentice-Hall, 1971), 58, 68.

useful for consolidating and ordering America's population as well as for comprehending the geological history of the West that revealed its mutable character.

At the start of Cooper's narration he revealed how firmly the watery past of the western prairies gripped his mind. The broad arid stretches of the West suggested both oceanic metaphor and scientific reality to the former sailor.[15] "The earth," Cooper commented, "was not unlike the ocean." They were analogous because as Cooper saw it they shared the "same waving and regular surface, the same absence of foreign objects, and the same boundless extent to the view." The ocean and the Great American Desert were so similar that "however much the geologist might sneer at so simple a theory, it would have been difficult for a poet not to have felt, that the formation of the one had been produced by the subsiding dominion of the other."[16] Clearly Cooper's vision of the West was informed by Long's Great American Desert and by the geologic history of the region.

It is possible that Cooper also saw the dewatering of the continent as a sign of natural degeneration.[17] The garden had long abandoned the West and now all that was left was vestiges of its former glory in a land of desiccated decay. The western desert stage was symbolic of his lament for the unbridled forward march of civilization that had lain to waste the fragile environments of North America. Cooper suggested that the Great American Desert served as a warning of the consequences of rapacious exploitation of the nation's natural resources. Cooper's trapper contemplated the meaning of the arid

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[15] Overland, *James Fenimore Cooper's the Prairie*, 152-153.
[16] Cooper, *The Prairie*, 6-7.
[17] Bevis, "The Prairie: Cooper's Desert Ecology," 14.: As will be seen in Chapter 8, this was like Percival Lowell who later would see the process of the North American continent dewatering through Dana's maps as a sign of Earth's dessication.

stretches in the West and stated, "I often think the Lord has placed this barren belt of prairie behind the States, to warn men to what their folly may yet bring the land!"[18] The future of the land was hopeless in the hands of humanity's wanton and reckless nature. The small sections of timbered land would fall victim to waves of civilization "and then the land will be a peopled desert, from the shores of the main sea to the foot of the Rocky Mountains; filled with all the abominations and craft of man, and stript of the comforts and loveliness it received from the hands of the Lord!"[19] The West was even where Cooper's legendary character Leatherstocking (or Natty Bumppo) went to die, thereby concluding Cooper's five-book series centered on the exploits of this fearless frontiersman. In the vast expanses of the West, humanity came face-to-face with its own mortality.

Cooper's West was simultaneously a land of limits and of wild beauty where the land's arid fragility made changes wrought by civilization easy to perceive. In *The Prairie* he questioned the idea of progress that fueled western expansion and ignored the land's natural limits.[20] In this way, some believe that Cooper foreshadowed John Wesley

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[18] Cooper, *The Prairie*, 19.
[19] Cooper, *The Prairie*, 218.
[20] Franklin, *James Fenimore Cooper: The Early Years*, xxviii-xxix.; Goetzmann, *New Lands, New Men*, 189.; John J. Murphy, "Cooper, Cather, and the Downward Path to Progress," *Prairie Schooner* 55, no. 1/2 (1981): 168-184.; Roderick Nash, *Wilderness and the American Mind*, 4th ed. (New Haven London: Yale Nota Bene, 2001), 77, 97.; David E. Nye, *America as Second Creation: Technology and Narratives of New Beginnings* (Cambridge, MA: The MIT Press, 2003), 71-72.; It has also been suggested by Smith that Cooper's aristocratic ideals led him to oppose the idea of the yeoman farmer which dominated Jeffersonian dreams of the garden West.: Henry Nash Smith, *Virgin Land: The American West as Symbol and Myth* (New York: Vintage Books, 1950), 247, 256-260.; See also: Kerwin Lee Klein, *Frontiers of Historical Imagination: Narrating the European Conquest of Native America, 1890-1990* (Berkeley, CA: University of California Press, 1997), 84, 220.; Spiller, *Fenimore Cooper, Critic of His Times*, 212, 245-251, 312-313.; Overland, *James Fenimore Cooper's the Prairie*, 144.; Anne Perrin, "Opened Frontiers, Closed Deserts: The Contradictions between Source and Text in James Fenimore Cooper's *the Prairie*," in *James Fenimore Cooper: His Country and His Art, Papers from the 2001 Cooper Seminar*, ed. Hugh C. MacDougall (Oneonta, NY: The State University of New York College at Oneonta, 2001).

Powell's vision for the West that will be discussed in the next chapter.[21] While discussing the antiquity of the West with the naturalist Dr. Battius, Cooper's Leatherstocking also saw the land in biblical terms. Cooper's representative of American science, Dr. Battius, served to poke fun at the limitations of scientific knowledge and categorizing.[22] In this exchange, Battius expressed his belief that the West to bore no signs of civilization's descent into the desert which were readily apparent in the "plains of Egypt and Arabia" where "their sandy deserts teem with the monuments of their antiquity" and now "lie stripped of their fertility."[23] It was ponderous Battius admitted "that nature did not make so vast a region to lie an uninhabited waste so many ages."[24]

Leatherstocking confessed his ignorance of Old Word civilizations but noted his experience "looking natur' steadily in the face," using his capacity for reasoned thought, and listening to "the words of the good book."[25] He knew the West to be old by listening to the Moravians in "the wigwams of the Delawares," and speaking to "the Great Serpent of the Delawares" also known as Chingachgook his Native American companion.[26] From these sources, Leatherstocking learned "that the Blessed Land was once fertile as the bottoms of the Mississippi, and groaning with its stores of grain and fruits." Unfortunately, "the judgment has since fallen upon it, and that it is now more remarkable

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[21] Bevis, "The Prairie: Cooper's Desert Ecology," 8, 11, 13.
[22] Franklin, *James Fenimore Cooper: The Early Years*, 51-52.; Donald A. Ringe, "Man and Nature in Cooper's the Prairie," *Nineteenth-Century Fiction* 15, no. 4 (1961): 317-323.; Cooper's critique of science seems slightly ironic since he used scientific reports to assist him in writing his book.
[23] Cooper, *The Prairie*, 280.
[24] Cooper, *The Prairie*, 280.
[25] Cooper, *The Prairie*, 280-281.
[26] For more information on Cooper's knowledge of the Moravians and the impact of their research and philosophy on his work, see: Edwin L. Stockton, Jr., "The Influence of the Moravians Upon the Leather-Stocking Tales," *Transactions of the Moravian Historical Society* 20, no. 1 (1964): 3-191.

for its barreness than any qualities to boast of."[27] Time had eroded all that once was the ancient civilizations of the West, and Leatherstocking explained to Battius, "[t]his very spot of reeds and grass, on which you now sit, may once have been the garden of some mighty king."[28] The American West could have been the stage for the Fall where the life-giving garden-West was destroyed by the Lord as a result of humanity's *hubris*. The West's history was the deep history of the world. America was a nation of nature. The desert-West was by design the product of a Fallen civilization and prophesized the end of civilization.[29] By dwelling in the desert lands of the West, these characters become desert-people, or perhaps more fittingly fallen people in a Fallen land. In the desert, Cooper's characters occupy a place that represents humankind's inherent faults and the wisdom of God.[30] Leatherstocking looked at what the naturalist saw as progress and civilization and saw only waste. The lesson that the desert-West should teach was that humanity's "power is not equal to his will."[31] Through the lens of scientific materialism Battius saw the nature as functioning like Cartesian machine, while Leatherstocking viewed the natural world holistically and as the dominion of God's morality.[32]

As discouraging as Cooper's vision of the West was for his readers, subsequent printings of *The Prairie* could not deny the forward march of the American people into the Great American Desert. Hope for the garden-West was triumphant when this novel

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[27] Cooper, *The Prairie*, 281.
[28] Cooper, *The Prairie*, 283.
[29] Hugh C. MacDougall, "'Their Waste Has Done It All': *The Prairie* as a Post-Apocalyptic Novel," in *James Fenimore Cooper: His Country and His Art, Papers from the 2001 Cooper Seminar*, ed. Hugh C. MacDougall (Oneonta, NY: The State University of New York College at Oneonta, 2001).
[30] Merrill Lewis, "Lost-and Found-in the Wilderness: The Desert Metaphor in Cooper's *the Prairie*," *Western American Literature* 5, no. Fall (1970): 196-197, 200-201.
[31] Cooper, *The Prairie*, 282.
[32] Franklin, *James Fenimore Cooper: The Early Years*, 53.; John J. McAleer, "Biblical Analogy in the Leatherstocking Tales," *Nineteenth-Century Fiction* 17, no. 3 (1962): 228-235.

was reprinted in 1877. Cooper's pronouncements that echoed those of Stephen Harriman Long and Zebulon Montgomery Pike were amended with an additional sentence.[33] The barrier formed by the western desert had been overcome. "Since the original publication of this book," it was noted in the 1877 introduction, "however, the boundaries of the republic have been carried to the Pacific, and 'the settler,' preceded by the 'trapper,' has already established himself on the shores of that vast sea."[34] Plans for extending the railroads "across these vast plains" served as further proof of changes being wrought that have served to burst through the desert barrier.[35] Furthermore, the original introduction was not entirely dismal. Abundant coal provided hope and a replacement for the absence of timber for those settlers on the cusp of the desert-West. Through the application of "art [technology]…to supply the deficiencies of nature," coal would help to augment the "scarcity of wood and water – evils of a serious character."[36] While he thought ill of these people, Cooper recognized the impatience inherent in American expansion and spoke of the "swarms of that restless people which is ever found hovering on the skirts of the American society," that soon after the Louisiana Purchase, "plunged into the thickets that fringed the right bank of the Mississippi."[37] The conclusion of *The Prairie* followed a group of men accompanied by a government expedition travelling the West and encountering a pastoral paradise.[38] In the end, Cooper did not believe in the desert-West as a permanent barrier, but rather a check on the rapid and unbridled expansion of

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[33] According to Orm Overland, the introduction was changed for the 1851 edition in light of "the changes that had taken place since the first publication." Overland, *James Fenimore Cooper's the Prairie*, 133.
[34] Cooper, *The Prairie*, vii.
[35] Cooper, *The Prairie*, vii.
[36] Cooper, *The Prairie*, vi.
[37] Cooper, *The Prairie*, 2.
[38] Cooper, *The Prairie*, 449-450.

America's unwashed masses. Cooper accepted that the West could be a pastoral paradise or garden for those of worth.[39]

Approximately three decades after Cooper's first edition of *The Prairie*, the western state of Colorado had a powerful prophet that sought to erase the desert-West from American's minds. Colorado's soon-to-be Territorial Governor William Gilpin, who had explored the West as a soldier on the famous 1843 Fremont Expedition, saw the West through rose-colored glasses.[40] For him, the desert simply did not exist. In 1860, Gilpin published *The Central Gold Region* where he directly discounted the existence of a desert. Gilpin confidently proclaimed:

> The scientific writers of our country adhere with unanimity to the dogmatic location somewhere of "a great North American desert." Travellers under their promptings, especially search for it. It has been located *seriatim* in advance of the settlements in Kentucky, in the North-west, in Missouri, upon the Plains, in California. No explorer or witness who has failed to find a desert, is allowed credence or fame. Yet there is none, either in North or South America; nor is the existence of one possible. On the contrary, the least fertile portion of our continent is the *silicious* maritime slope of the Atlantic States, whose climate is also the most inhospitable. Yet here is no desert, and none anywhere else exists. This dogmatic *mirage* has lately receded from the basin of the Salt Lake; it is about to be expelled from tis last resting-place, the basin of the Colorado.[41]

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[39] Overland, *James Fenimore Cooper's the Prairie*, 171.

[40] John C. Fremont also largely rejected the notion of the Great American Desert and wrote in his reports of the fertile regions he encountered in the West.; John Logan Allen, "The Garden-Desert Continuum: Competing Views of the Great Plains in the Nineteenth Century," *Great Plains Quarterly* 5, no. 4 (1985): 212.; For a biography of Fremont, see: Tom Chaffin, *Pathfinder: John Charles Frémont and the Course of American Empire* (New York: Hill and Wang, 2002).

[41] William Gilpin, *The Central Gold Region: The Grain, Pastoral and Gold Regions of North America. With Some New Views of Its Physical Geography; and Observations on the Pacific Railroad* (Philadelphia, PA: Sower, Barnes & Co., 1860), 92; Gilpin later reprinted and expanded this work as: William Gilpin, *Mission of the North American People Geographical, Social and Political: Delineating the Physical Architecture and Thermal Laws of All the Continents* (Philadelphia, PA: J. B. Lippincott & Co., 1873).

In the West, Gilpin believed, "[t]he capacity for population is indefinite."[42] Furthermore, "[t]he climate of the Great Plains is favorable to health, longevity, intellectual and physical development, and stimulative of an exalted tone of social civilization and refinement."[43] This paradise also abounded in fuel. "Bituminous coal is everywhere interstratified with the calcareous and sandstone formation," Gilpin observed, "…and is everywhere conveniently accessible."[44] He had faith that American settlement would advance rapidly into the West where he saw "the most magnificent dwelling-place marked out by God for man's abode."[45] The geographical result of the geology of the continent created conditions for a favorable climate as well as a central bowl that "receives and gathers towards its centre whatever falls within its rim!"[46]

In 1870, Gilpin explained in his *Notes on Colorado* that his faith in progress was supported by the power of steam. "Steam upon the ocean and upon the land, more potent than armies," he stated, "condenses labour, and magnifies indefinitely its power and its results."[47] The forward march of progress was advanced by "a vast *army* of pioneers" "a deluge of men, rising unabatedly, and daily pushed onward by the hand of God."[48] Grasping for a way to convey the character of the West, ocean metaphors and analogies pervaded Gilpin's references to the "Great Plains." The fertile plains arose from "the industry of multitudinous myriads of minute animals." In the ocean, Gilpin informed us,

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[42] Gilpin, *The Central Gold Region*, 115.
[43] Gilpin, *The Central Gold Region*, 124.
[44] Gilpin, *The Central Gold Region*, 123.
[45] Gilpin, *The Central Gold Region*, 184.
[46] Gilpin, *Mission of the North American People*, 99, 104, 143.
[47] William Gilpin, *Notes on Colorado and Its Inscription in the Physical Geography of the North American Continent* (London: Printed by Witherby and Co., 1870), 27.
[48] Gilpin, *Notes on Colorado*, 28.

this work was performed by "zoophites" that "erect coral islands," while in the West, the ants, marmots, badgers, foxes, and wolves labor to create the fortuitous condition of the land.[49] "As large in expanse as is the Atlantic sea," Gilpin expanded upon his oceanic analogy, "the winds sweep over and mould its surface, as completely as they ruffle the water surface and drive the waves of the ocean."[50] This "ocean prairie" as he described it, was "[o]f the fattest fertility."[51]

Not only was Gilpin's mind captivated by an oceanic analogy that colored his descriptions of the Great Plains, he recognized that the economic vitality and success of the West was built on an ancient sea. "The Northern Andes everywhere prove themselves to have been driven up through the bed of a primeval ocean," Gilpin geologized, "of which the Mississippi basin is the still unaltered bowl."[52] The remains of this ancient ocean were readily apparent as "[e]ach stratum having its characteristic colour, this fringe of a departed ocean is traced without intermission lengthwise through the continent."[53] In this "continuous rainbow" of stratified earth "[a]t the lower end appears diluvial drift the top settlings of the sea; at the other end the primeval porphyry, upheaved from the lowest crust." In Gilpin's Manifest Destiny-infused geological imagination, it was "[h]ere, in economical juxtaposition and luxuriant profligacy, are found every metal, every rock, every clay, every salt, every alkali, fuel, arborescence, vegetation of grasses and flora – every and each element of the geological scale to which human industry applies its skill,

[49] Gilpin, *Notes on Colorado*, 34-35.
[50] Gilpin, *Notes on Colorado*, 35.
[51] Gilpin, *Notes on Colorado*, 35.
[52] Gilpin, *Notes on Colorado*, 42; Gilpin, *Mission of the North American People*, 64.
[53] Gilpin, *Notes on Colorado*, 43.

or manufactures and converts to social use."[54] Gilpin concluded that because of its geologic past and natural conditions, the West "fans the immortal fire of patriotism, and beckons on the energetic host of our people."[55] This "Divine task! Immortal mission!" required faith and the providentially placed petrified remains of past life.[56]

Even Gilpin's geographic term for the West was derived from its watery geologic past. He was fixated on the fact that the western plains were composed of calcareous sediments. These types of sediments are composed of calcium carbonate derived from the death of millions of marine organisms that once occupied the Western Cretaceous Interior Seaway. A beautiful map included in his text reveals the extent of what he termed the "Great Calcareous Plain" or what he also calls the "*Calcareous Plain of North America.*"[57] In these "calcareous plains" could be found fertile soils for farming and ranching and all of the necessary metals and minerals for America's industrial future [Figure 43].[58] The West would be awakened, according to boosters like Gilpin, through the use of the slumbering geological resources awaiting exploitation. [59] The West was made by God for the advantage of Americans.[60]

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[54] Gilpin, *Notes on Colorado,* 43.
[55] Gilpin, *Notes on Colorado,* 46.
[56] Gilpin, *Notes on Colorado*, 52.
[57] Gilpin, *Mission of the North American People*, 34-35, 168.
[58] Gilpin, *Mission of the North American People*, 55, 64, 71, 73, 117, 168, 169, 171.
[59] A recent study supports Gilpin's claim about the marine nature of North American affecting its agricultural future. The shoreline of the Cretaceous Seaway produced excellent cotton growing soils in the southeastern portion of the United States. In this region, a high density of cotton plantations and slave ownership developed. Today, the historical effects of the seaway resonate in politics as the former Cretaceous Seaway shoreline contains large populations of African Americans known as the "Black Belt."; Craig R. McClain, "How Presidential Elections Are Impacted by a 100 Million Year Old Coastline," *Deep Sea News*, June 27, 2012. http://deepseanews.com/2012/06/how-presidential-elections-are-impacted-by-a-100-million-year-old-coastline/.; If Edmund Russell is correct in stating that "Amerindians, New World cottons, and anthropogenic evolution in the Americas made the Industrial Revolution possible." His emphasis on slavery makes it so that perhaps we can add the Cretaceous Seaway to this equation that culminated in industrialization. It may be best to think through history using a geo-evolutionary

The American public was hungry for land regardless of dismal reports of desert barriers.[61] Separated by thirty years of history, Cooper and Gilpin used geology to support their worldviews.[62] Science was increasingly considered synonymous with authority and these men took rhetorical advantage of geology to support their visions of the West. While the desert-West was a dominant image during Cooper's time, Gilpin was on the forefront of boosting the West in order to overcome that image. The reports of a Great American Desert were being cast off at the conclusion of the Civil War as citizens were encouraged to follow their dreams in the West. The U. S. government encouraged the destruction of the desert-West through expansive surveys and the revolutionary 1862 Pacific Railway and Homestead Acts. The West was also where agents of industrial capitalism would begin to direct their attention and encourage visions of prosperity through advertising the previously maligned region. As will be discussed in the next two chapters, in the wake of the Civil War, the garden awoke from its slumber as political, economic, scientific, and cultural forces drove flocks of migrants to untested lands. The West's geologic history played a vital role in this process. The rest of this chapter will

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perspective.; Edmund Russell, *Evolutionary History: Uniting History and Biology to Understand Life on Earth* (New York: Cambridge University Press, 2011), 104.

[60] Another example of mustering the geological history of North America to support a progressive vision of natural history and the geological origins of America's greatness comes from a soldier named Edward Bissell Hunt. In 1863, he stated, "[t]hrough myriad years of preparations, the earth had been prophetically forming for man's habitation, and now, for six thousand years, he has been expanding over its surface, and through all fluctuations has been shaping it to his needs." Furthermore, "the earth was not only deliberately framed and organized to be man's habitation, but so specially combined as to prescribe and prophesy the actual order of human history."; Edward Bissell Hunt, *Union Foundations: A Study of American Nationality as a Fact of Science* (New York: D. Van Nostrand, 1863), 8-9.

[61] For a brief history of the transition from the Great American Desert to the rapid settlement of what many hoped to be a garden-West, see: Robert G. Athearn, "The Great Plains in Historical Perspective," *Montana: The Magazine of Western History* 8, no. 1 (1958): 13-29.

[62] Clarence King also used a description of the watery past of the North American continent to express the ancient, romantic, and sublime nature of the Sierra Nevada Mountains and to set up his tale.; Clarence King, *Mountaineering in the Sierra Nevada* (Boston, MA: James R. Osgood and Company, 1872), 1-5.

illustrate just how pervasive paleontological and geological interest was in post-Civil War America and consequently why these sciences could be called upon in popular and booster literature in order to justify their author's aims.

The Industrialized American Media, Public Display, and Fossils

It was not simply the scientific elite of America that were interested in and advanced scientific knowledge, but also the curious amateurs and general public that gave their free time to the study of the natural world.[63] Chapter 5 covered the experience of westerners with fossils, while this section takes this exposure to the national stage. Here the media produced in the late nineteenth century pertaining to paleontology and geology will be examined in order to gauge the extent of coverage pertaining to these sciences. It will also discuss what the public may have thought about these sciences and what they had to reveal about the West and the natural world. A crucial factor in the expansion of public interest in natural history was the growth of the transcontinental railroads and extension of telegraphs lines that spread scientific news and literature inexpensively and rapidly across the continent.[64] The public could see, touch and hear about scientific discoveries that were happening in previously prohibitively remote regions of the West. In a sense it was an information revolution on par with the World Wide Web today. Inquisitive individuals in relatively remote regions of the country could now satisfy their curiosity concerning the natural world. Boundaries of expertise were

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[63] Mark V. Barrow, "The Specimen Dealer: Entrepreneurial Natural History in America's Gilded Age," *Journal of the History of Biology* 33, no. 3 (2000): 493-494.; Daniel Goldstein, "'Yours for Science': The Smithsonian Institution's Correspondents and the Shape of Scientific Community in Nineteenth-Century America," *Isis* 85, no. 4 (1994): 577, 583.

[64] " Barrow, "The Specimen Dealer…", 494.

compromised by the opening of the western field where local knowledge was a necessary component of field science. Through their own explorations and independent reading, these locals could also become proficient in some practical elements of field science such as specimen identification.

The revival of the garden West was triggered by the late nineteenth-century industrialization of the American nation. During this period of transition, nostalgic visions were operating simultaneously on two levels of time. As paleontologists probed the deep past and revealed its mysteries, aspirations to return to the verdant abundance of these paleo-landscapes developed. At the same time, the rapid reduction of the mythical frontier, or "The West of the Imagination," caught many Americans off guard, and they felt at least a superficial sadness at the loss of the violent West inhabited by gallant or grisly gunmen and bloodthirsty or noble Native Americans.[65] The life of Buffalo Bill Cody encompassed these nostalgic narratives. The fossil hunters J. P. Sams and Barnum Brown were clearly aware of and took time to note in their journals their experiences connected to the legendary Buffalo Bill Cody as they traveled the West in 1895. Elements of Cody's mythos likely sunk into what any traveler through the West saw as they experienced the arid landscape and watched the remnants of the Wild West fading into the dust. While in Lusk, Wyoming, Sams saw Jerky Bill who was once a Bronco Rider in Buffalo Bill's Wild West Show.[66] Also, as Brown was travelling up the Great

[65] William H. Goetzmann and William N. Goetzmann, *The West of the Imagination* (New York: Norton, 1986).
[66]Barnum Brown and James Polk Sams, *A Triceratops Hunt in Pioneer Wyoming: The Journals of Barnum Brown & J.P. Sams: The University of Kansas Expedition of 1895* ed. Michael F. Kohl, Larry D. Martin, and Paul Brinkman (Glendo, WY: High Plains Press, 2004), 108.

Platte River Road, he camped outside of Cody's Scout Rest Ranch.[67] These experiences were noteworthy enough to record in their journals as they traveled in the tamed West of 1895 and saw the region through the same lens of romance and nostalgia offered as entertainment in Buffalo Bill's Wild West Show.

By the late nineteenth century, Buffalo Bill had become a symbol of the romance of the violent frontier West and the disappearing Native American presence on the western plains.[68] His show was built on historically-rooted nostalgia infused with sanitized romantic visions that on its surface regretted the plasticity of the West and the breakneck pace of western settlement enabled by America's industrialization.[69] Ironically, Cody's show itself was an industrial show and by 1896 was even traveling with electrical generators to power its massive mobile show.[70] The "mass culture" dissemination of Cody's nostalgic Wild West was constructed upon the very technologies that provoked lamentations over a lost land of larger-than-life legends.[71] The transcontinental railroads were at the heart of the post-Civil War transformation of the United States. Just as the transcontinental railroads were integral to the employment of Buffalo Bill as a hunter, scout, and showman, the iron horse carried the weight of American science.

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[67] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 43.
[68] For a discussion of Buffalo Bill's relationship to Native Americans, see: Bobby Bridger, *Buffalo Bill and Sitting Bull: Inventing the Wild West* (Austin, TX: University of Texas Press, 2002).
[69] Goetzmann and Goetzmann, *The West of the Imagination*, 287-297.
[70] Louis S. Warren, *Buffalo Bill's America: William Cody and the Wild West Show* (New York: Alfred A. Knopf, 2005), 445.; Robert W. Rydell and Rob Kroes, *Buffalo Bill in Bologna: The Americanization of the World, 1869-1922* (Chicago, IL: University of Chicago Press, 2005), 31.
[71] Rydell and Kroes, *Buffalo Bill in Bologna*, 6-7.

Before achieving his fame as a showman, Cody periodically took employment as a western guide.[72] Along with the Pawnee guides employed by famed paleontologist O.C. Marsh, the Army scout Buffalo Bill joined as an escort. During Buffalo Bill's brief stay with the western paleontological Yale Expedition of 1870, Marsh recounted the wonders of a paleo-sea that covered the plains and lapped against the mountains. Cody had found Marsh "to be not only a well-posted person but a very entertaining gentleman" and they fostered a friendship well into the period when Cody became the famous showman that defined the Wild West.[73] Amidst dramatic accounts of narrow escapes from Native Americans, Cody remarked in his autobiography that Professor Marsh "gave me a geological history of the country; told me in what section fossils were to be found; and otherwise entertained me with several scientific yarns, some of which seemed too complicated and too mysterious to be believed by an ordinary man like myself…As we rode along he delivered a scientific lecture, and he convinced me that he knew what he was talking about."[74] Cody admitted to having less of a scientific mind than Marsh, but he nevertheless was open to an education on the geology of the West and areas where the fossilized remains of the denizens of the deep past were deposited.

One of the publications that arose out of the 1870 Expedition was a piece by Marsh's student Charles Betts in *Harper's New Monthly Magazine*. Betts' account of Marsh's education to Cody illustrates another perspective on the purpose of the paleontologist's descriptive prose and its effect on Cody:

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[72] For a biography of Buffalo Bill Cody, see: Warren, *Buffalo Bill's America*.
[73] William F. Cody, *The Life of Hon. William F. Cody, Known as Buffalo Bill, the Famous Hunter, Scout and Guide: An Autobiography* (Hartford, CT: F. E. Bliss, 1879), 280.; Charles Schuchert and Clara Mae LeVene, *O.C. Marsh, Pioneer in Paleontology* (New Haven, CT: Yale university press, 1940), 103.
[74] Cody, *The Life of Hon. William F. Cody*, 280.

> The object of the expedition greatly puzzled our military companions of the rank and file; but Professor Marsh, as we rode along, endeavored to explain to them the mighty changes of geology, and the grand discoveries that we would make. "Buffalo Bill," the famous frontier hunter, accompanied us the first day's journey, and at the camp fire that night remarked to the soldiers, "The professor told the boys some mighty tough yarns to-day; but he tipped me a wink, as much as to say, 'You know how it is yourself, Bill!'"[75]

According to Betts, Marsh hoped to educate their lay company as to the geohistory of the land they were traversing. One of the soldiers accompanying the Expedition, however, seemed to have missed Marsh's point.

> After fourteen hours in the saddle, one of the soldiers, exhausted with heat and thirst, finally exclaimed, "What *did* God Almighty make such a country as this for?" "Why," replied another more devout trooper, "God Almighty made the country good enough, but it's this deuced geology the professor talks about that spoiled it all!"[76]

After experiencing the extreme western heat and aridity, this soldier had more in common with Cooper than Gilpin in understanding the implications of the region's geologic history [Figure 44]. When paired with a little education in geology, the western landscape could be seen in a multitude of ways. In this case a degenerated landscape. Significantly, Betts' article was in a nationally distributed publication through which these thoughts could spread. Through entertaining pieces like this, the public would come to understand western geology and make up their minds as to what it all meant.

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[75] Charles Wyllys Betts, "The Yale College Expedition of 1870," *Harper's New Monthly Magazine*, October 1871, 663-664.; Also, see Marsh's biography by Schuchert, LeVene, and Hamilton for another perspective on this exchange.: Schuchert and LeVene, *O.C. Marsh, Pioneer in Paleontology*, 103.
[76] Betts, "The Yale College Expedition of 1870," 664.

Besides its famous guide, this fossil hunting expedition was exceptional because of the public attention and press paid to its western adventures.[77] According to William Wyckoff, who wrote an account of one of his fossil hunting expeditions, Marsh's "annual journeys in search of vertebrate fossils at the west have become well known."[78] Beyond writing an account of Marsh's exploits, Wyckoff could credit himself with contributing to this feat. He was a popularizer of science as the scientific editor for the *New York Tribune* from 1869 to 1878. In this position, reporting on the AAAS and American science he received "wide recognition as [writing] the best scientific reports that were ever made for a daily paper."[79] In 1875, in response to a Smithsonian Institution circular, he stated that he was "[i]n charge of all matters relating to science" for the *Tribune*.[80] Spencer Baird of the Smithsonian wrote kindly to Wyckoff and believed that he understood the "public pulse" in scientific matters.[81] With Wyckoff at the helm of scientific reporting at the paper, Baird encouraged his scientific friends to write to the *Tribune* since it was

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[77] Lawrence W. Bradley, "Dinosaurs and Indians: Paleontology Resource Dispossession from Sioux Lands" (PhD diss., University of Nebraska, 2010), 44.; Wyckoff, "A Perilous Fossil Hunt," 258.; There were a number of these types of fossil adventure stories that were published in the late ninteenth and early twentieth centuries. For example, see: William H. Ballou, "Strange Creatures of the Past. Gigantic Saurians of the Reptilian Age," *Century Magazine*, 1897, 15-23.; Howard W. Bell, "Fossil-Hunting in Wyoming," *The Cosmopolitan: A Monthly Illustrated Magazine*, 1900, 265-275.; Barnum Brown, "Hunting Big Game of Other Days," *National Geographic*, 1919, 407-429.; Henry Fairfield Osborn, "Fossil Wonders of the West," *The Century Magazine*, September 1904, 680-694.; Henry Fairfield Osborn, "Hunting Prehistoric Animals," *Appleton's Magazine*, 1906, 552-554.

[78] William C. Wyckoff, "A Perilous Fossil Hunt," in *The Indian Miscellany; Containing Papers on the History, Antiquities, Arts, Languages, Religions, Traditions and Superstitions of the American Aborigines; with Descriptions of Their Domestic Life, Manners, Customs, Traits, Amusements and Exploits; Travels and Adventures in the Indian Country; Incidents of Warfare; Missionary Relations, Etc.*, ed. W.W. Beach (Albany, NY: J. Munsell, 1877), 258.; The 1877 version is used here in this dissertation to illustrate that the piece that was originally published in the *New York Tribune*, No. 27, March, 1875, was popular enough to warant reprinting.

[79] James Grant Wilson and John Fiske ed., *Appleton's Cyclopedia of American Biography* Vol. 6 (New York: D. Appleton and Company, 1889), 630.

[80] Answers to Circulars, Uhler – Younglove." Smithsonian Institution Archives. SIARU007002 Box 64 Folder 10.

[81] Letter from Spencer Baird to William C. Wyckoff, February 5, 1874. Smithsonian Institution Archives. RU53, Microfilm Vol. 15, Reel 14.

"extending its relationship to American Science."[82] Yet, Wyckoff was not always happy with the way the *Tribune* treated science. In 1875, he lamented, "[t]he *Tribune* is crowded by news and advertisements as never before at this season. Science suffers."[83] Wyckoff was a dedicated science writer who provided a window for the public into the scientific establishment.

To be sure, not every American understood or even cared about science. Just as today, the public's aptitude and appetite for science was variable. Two examples from the late nineteenth century serve to illustrate this point. The first comes from a letter written to the editors of *Harpers Weekly*. The individual identified himself as "H. H. A Subscriber," and wrote to the editors to express the plight of the non-specialist reading science published in *Harpers*. The reader explained that he belonged "to that large Class of Man, to whom only a common [*lot*] of Education was allotted, and who by all possible means are trying, and devoting their leisure hours to the acquirement of additional information." *Harpers Weekly* and *Monthly* were recognized by the reader as "welcome and beneficial." However, while he would spend "several hours" reading their contents, the recent issue seemed to have sparked exasperation. So, H. H. responded with a jest directed at the enterprise of science.

> I agree fully with the writer on page 119, that we have to be thankful to Professor Agassiz for his information about trillobites, phyllopods, entomostracea, and isopods although the learned professor say's nothing about teapod (t)s, coffeepod(t)s, flowerpod(t)s, and the multitude of other plain and comprehensive pod(t)s. Still I enjoyed that very

[82] Letter from Spencer Baird to Elliott Coues, August 16, 1873. Smithsonian Institution Archives. RU53, Microfilm Vol. 14, Reel 13.
[83] Letter from William C. Wyckoff to Spencer Baird, September 1, 1875. Smithsonian Institution Archives. SIARU007002 Box 36 Folder 7. "Wyckoff, William, 1875-1882."

> much. But the crowning amount of information I found in a small article of 48 lines on page 123. There we have Eocene, Diocerea, Tinoeras, awceps, Uintatherium robustrum Tinoceras again, Eobasilius, Dinoceras mirabilis, probascidians, and once more Dinocerea - !

The scientific terminology that was spread throughout the pages of *Harpers* was a little too much for H. H. In the end, he concluded that knowing this information "makes me feel admirabilis, and through my cranium are running all sorts of nonsensicalisis." H. H. believed he was not alone. "I am convinced," he stated, "that the millions of fellow Beings, in similar position as your humble correspondent, will be very glad, to get more of that, and also some more of the pod (t)s."[84]

Indeed H. H. was not alone. Another example comes from 1884, in Laramie, Wyoming's *The Boomerang* newspaper. The title of the article was "Geology of Wyoming" and it concerned a map published from Hayden's geological studies of Wyoming and Colorado from 1869 to 1880. The article quoted a description from the Philadelphia Press that indicated the importance of fossils in trying to solve the mystery of the Laramie formation as to whether it is Tertiary or Cretaceous. It was a "battle ground of the paleontologist[s]" who were debating the issue. Although the reporter was not up to the scientific fight.

> We give it up also. While our first thought was that it was tertiary and plenipotentiary, with perhaps a trace of Greek statuary, further investigation developed much that would indicate, to the man in the moon, that the area referred to was both cretaceous and cutaneous. To say that it is spontaneous, also, is to presume; while the theory that it is extemporaneous will not bear the light of scientific glim. The question, we admit, is a little too thick for us. If,

[84] Letter from H. H. a Subscriber to Editors of *Harper's Weekly*, February 2, 1873, Smithsonian Institution Archives. SIARU007002 Box 24 Folder 8. "Harper and Brothers, January – May 1873."

> however, we have thrown out any hints in the foregoing which will aid these paleontologists any, they are welcome to the information.[85]

For some of America's public, scientific literacy could be a frustrating and ridiculous endeavor. These two examples, however, show that while it was easy to poke fun at the rhetoric of science and its insular debates, interest in scientific knowledge remained.[86]

There was clearly a significant segment of the American population with an insatiable hunger for tales of the West's geologic history and its monstrous inhabitants. Beyond Betts' reporting, the Expedition attracted local and national media attention.[87] One such article reprinted from the July 10, 1870, *Omaha Republican* appeared a week later in the *San Francisco Chronicle* under the title, "THE YALE SCIENTIFIC PARTY. The Importance of the Expedition – Remarkable Discoveries." The article detailed the commencement of the journey at Fort McPherson where the party "will be furnished with a sufficient escort of cavalry to insure their perfect safety."[88] The reporter was sure to encourage the citizens of the region to help Marsh in his scientific work in the West. The

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[85] "Geology of Wyoming," *The Boomerang*, February 4, 1884.

[86] Sometimes the Smithsonian would also receive nonsense answers to their circulars as well. For example, a railroad baggage and switchman from Illinois stated that the subjects he was most interest in were "Smashing trunks & getting a good cussing for the damage some one else was guilty of.": "Answers to Circulars, Talbot – Tyson." Smithsonian Institution Archives. SIARU007002 Box 64 Folder 9.; Another example comes from a 1901 news article about the discovery of "the fossil bones of antediluvian monsters." The reporter stated, "[t]hese bones are supposed to be part and portion of a monster lizard with an unpronounceable scientific name.; "Interesting Fossils," *Deseret Evening News*, August 1, 1901.

[87] Other news accounts include: "Yale Scientific Expedition," *New York Times*, September 3, 1870.; "Yale Scientific Expedition," *New York Times*, August 9, 1870.; The 1870 Yale Expedition even made into railroad booster material.: Henry T. Williams, ed., *The Pacific Tourist: Illustrated Trans-Continental Guide of Travel, from the Atlantic to the Pacific Ocean* (New York: Henry T. Williams, Publisher, 1877), 106.

[88] "The Yale Scientific Party. The Importance of the Expedition - Remarkable Discoveries," *San Francisco Chronicle*, July 17, 1870.; For more on this expedition see the work of Mary Pankin.: Mary Faith Pankin, "The Yale Scientific Expedition of 1871: A Student's-Eye-View," *Oregon Historical Quarterly* 99, no. 4 (1998): 374-435.; Mary Faith Pankin, "George G. Lobdell, Jr. And the Yale Scientific Expedition of 1871 at Fort Bridger," *Annals of Wyoming: The Wyoming History Journal* Winter (1998): 25-44.; Mary Faith Pankin, "The Yale Scientific Expeditions in Kansas," *Heritage of the Great Plains* 35, no. Fall-Winter (2002): 20-35.

article stated, "we hope that our citizens will do all they possibly can to assist the Professor and his party, and especially to call their attention to any localities, or specimens of bones or other fossils with which they may be acquainted."[89] The reporter even noted that Marsh expected that "with the assistance of those who are acquainted with the country, he will be able to make an addition to this branch of science that will be not only of interest, but of immense value to the scientific world."[90] This article illustrated the crucial nature of local knowledge in fossil prospecting in the Western field to the "scientific world." They presumably could identify specimens of worth and knew of their relevance to scientific study.

But what did these individuals think of the fossils they found? What could the public have been thinking about fossil finds in the West? Like coal's divine qualities, God played a role in the way in which some understood fossils and the geologic past. For example, religion and geology merged when the Yale party visited the Union Pacific Railroad's Green River cut in southwestern Wyoming. This window into the earth revealed a wealth of fossil fish for the marveling eyes of western travelers, and as will be discussed in the next section this depot was where these fossils were peddled to passengers. Betts' story of the Green River visit is comical and revealing of the audience for which he was writing:

> Here, in an eocene deposit, petrified fishes abounded; and we found a small bed containing fossil insects – a rare discovery, although in Western hotels beds are common where the insects are not petrified. Here were beetles and dragon-flies and grasshoppers, the ancestors, perhaps, of locust-like swarms that still infest this valley. A gigantic

[89] "The Yale Scientific Party."
[90] "The Yale Scientific Party."

> fossil mosquito, and an extinct flea, of dimensions not to be despised, contributed to our collection; so that if the primeval Adam really existed in the tertiary period, as some have supposed, the slumbers of himself and worthy spouse were doubtless disturbed like those of mortals since the fall.[91]

Betts gives us insight into the condition of western hotels, and more importantly for this analysis he considers a theory that united biblical references to geological terminology and paleontological remains. How popular the idea was that the Garden of Eden actually occurred during the Tertiary period is difficult to know. However, if this student of the paleontological master Marsh considered it semi-viable or even worth joking about, it likely had some traction in the public.[92] Furthermore, once this account was published in *Harper's*, the idea had the opportunity to grow new legs and walk amongst the minds of the public. This belief also coincides with the paleo-restorative dream in relation to restoring the Edenic West. Signs of the verdant and tropical Tertiary abounded in the West and allowed people to see the plasticity of the arid plains. The "Great American Desert" may only have been a product of the Fall, and it was now up to the Godly people of the United States to enact Manifest Destiny and restore the Eden of the Tertiary.[93]

News of fossil finds tended to excite the public and therefore many newspapers reported on these events. This was likely in part a product of the telegraph's association

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[91] Betts, "The Yale College Expedition of 1870," 671.
[92] The following news article from 1885 indicates that some believed that humans were around in the Tertiary. The article states "Geologists tell us that he was here in the tertiary era...": "Dead Continents," *San Francisco Chronicle*, February 8, 1885.
[93] Carolyn Merchant, *Reinventing Eden: The Fate of Nature in Western Culture* (New York: Routledge, 2003).; Nye, *America as Second Creation*.

with the railroad lines across the country.[94] Newsworthy occurrences along the lines could get into the hands of a telegraph operator quickly and then make their way across the nation faster than the iron horse itself.[95] Another example Arthur Lakes recounted in a letter to Marsh. He stated, "I see in the paper of yesterday that the graders on the Platt Canon have discovered bones if so I expect they are of the same group as ours as the canon + grade pass right through Dakota No. 1."[96] In this interconnected world, fossils could find their way into the homes of every American.

Additionally, one more such instance where the media granted insight into popular conceptions of fossilized remains comes from another find along the railroad. The western railroads unintentionally generated a labor pool of fossil finders for paleontologists seeking specimens.[97] One such event involves O. C. Marsh at Antelope Station, Nebraska in 1869. At this station, Marsh was alerted by the conductor of his train to bones found by well diggers and confirmed by a geologist working for the Union Pacific.[98] The event was of such significance that it was resurrected by a reporter while writing an article on the 1870 Yale Expedition. What followed was what a reporter

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[94] David Hochfelder, *The Telegraph in America, 1832-1920* (Baltimore, MD: Johns Hopkins University Press, 2012).; Robert Luther Thompson, *Wiring a Continent: The History of the Telegraph Industry in the United States, 1832-1866* (Princeton, NJ: Princeton University Press, 1947).

[95] For example, Spencer Baird of the Smithsonian Institution would receive favors from the Western Union Telegraph Company.: Letter from Spencer Baird to John Van Home Esq., Vice President of the Western Union Telegraph Company, January 27, 1882. Smithsonian Institution Archives. RU53, Microfilm Vol. 26, Reel 25.; However, telegrams were not always submitted well and scientific knowledge could get scrambled. For example, see the note at the bottom of the following report by Cope.: Edward Drinker Cope, "Notice of Proboscians from the Eocene of Southern Wyoming," *Proceedings of the American Philosophical Society* 12, no. 86 (1871): 580.

[96] October 1, 1877; Arthur Lakes Letters and Sketches to O.C. Marsh from Morrison CO. 1877-1879; Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).

[97] Robert West Howard, *The Dawnseekers: The First History of American Paleontology* (New York: Harcourt Brace Jovanovich, 1975), 178-179, 190-191.; Keith Stewart Thomson, *The Legacy of the Mastodon: The Golden Age of Fossils in America* (New Haven, CT: Yale University Press, 2008), 173.

[98] Howard, *The Dawnseekers*, 190-191.

reckoned to be the "value to the scientific world" in examining such discoveries. The 1870 newspaper article recounted the event as follows:

> To give an idea of the importance of this work [the work of the 1870 Yale College Expedition], we wish to call attention to what some of our readers remember as having read in regard to the reported discovery of human remains in a well sixty-eight feet below the surface, at Antelope Station, on the Union Pacific Railroad in the western part of Nebraska, in June 1868, full accounts of which were published in the papers at that time.
>
> During a visit to the Rocky Mountains in August of that year, Professor Marsh examined the locality and obtained a quantity of these supposed human relics. An examination at once convinced him that they were the remains of extinct animals of the Tertiary period.[99]

At the time of the event, as the above article noted, news of the event spread far and wide.[100] Marsh's scientific knowledge enabled him to dispel the false notions that initially surrounded the find. But what was the extent of these false notions?

To lend insight into the initial interpretation of the bones as they came out of the earth, an 1868 *New York Times* article revealed the popular understanding of the fossils at Antelope Station. The reporter described the find as "exceedingly interesting, and, perhaps, profoundly important," because what was found was "a layer of human bones – undoubtedly human." He confessed ignorance, but was hopeful that the discovery "would attract the attention of geologists and scientific men" to examine the remains. "For if it be correct that human bones are found in the ordinary line of formation in the tertiary," the reporter remarked, "I suppose there will have to be some revision of current scientific

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[99] "The Yale Scientific Party."

[100] It was also noted by Hayden in the second USGS report where he lamented that the whole region has not yet been studied by scientists.: Ferdinand Vandeveer Hayden, *Preliminary Report of the United States Geological Survey of Wyoming and Portions of Contiguous Territories*; *Being a Second Annual Report of Progress* (Washington: U.S. Government Printing Office, 1872), 110.

opinion both as to the origin of the human race and the date of its existence upon this planet." Then the reporter abandoned his professed skepticism and stated "that a friend of mine in this city, who has passed over the road, has femoral bone in his possession, which proves beyond a question that the relics are of the human race." Furthermore, these human remains were found with "the remains of elephants and tigers were unearthed, it is known to everybody that these animals are extinct species on this continent." The final statement of the reporter lends additional insight into the at least assumed perspective of some of the public regarding fossilized remains.

> These remains were the subject of a rather amusing inquiry at Laramie, by a hirsute, sloucay, very rough and yet highly theological frontiersman who said to the possessor of the strange relics, looking at them curiously as he spoke: "Oh! some bones! What sort, eh?" "Well, I think, the femoral bone of a man," was the answer. "Wh-a-a-t?" drawled out of the rude man of the Plains, with terrible emphasis. "A man's hip bone," replied my friend. "How you suppose they got there?" "I don't know." "You believe they were buried there?" "Yes!" "When?" "Well I say a million years ago!" "Ha! ha!" roared out of the frontiersman, "You're one of them fellows that don't believe in the Bible." "Why not?" said my friend. "Well, don't you know the Bible says Adam made the world out of dirt 3,000 years ago?" Well, yes!" was the reply; "I believe the Bible does say something of that kind" – the last speaker evidently having in mind the maxim that "it is dangerous to argue with the master of thirty legions," and his opponent in this instance having in full view an Arkansas bowie-knife and a brace of revolvers.[101]

The idea that there were humans in the Tertiary once again was presented as a plausible hypothesis. The article also indicated the presence of devout frontiersmen in the West

[101] "On the Wing in the Far West: Strange Discovery of Human Bones at Antelope Station - a Question for Savans - Frontier Theology - Rocky Mountain Scenery - Life at Laramie," *New York Times*, June 22, 1868.

that held the biblical (or some version of it) chronology of Earth's history to be true. [102] In fossils, as in the geologic history of North America, there were a number of narratives waiting to be generated from the pairing of the material and the mental.[103]

While it may be tempting to consider a probable consensus among scientists regarding an age of the Earth that extended beyond the biblically specified six thousand years, it is important to recognize that even scientists and fossil hunters were using language that contained biblical referents and conjured biblical imagery. As mentioned in a previous chapter, Ferdinand V. Hayden was using the term "Pre-Adamite" to describe geological and paleontological specimens in 1855.[104] Also, as late as 1878, the caption of an illustration of a paleontological specimen by Arthur Lakes in *Scientific American* read "Antediluvian Remains Discovered in the Rocky Mountains" [Figure 45].[105] Similarly, Charles Sternberg, when asked by a farmer what he was doing digging in a ravine, he replied, "Digging up antediluvian relics."[106] The term "pre-Adamite" refers to a period before the first human according to Genesis and the term "antediluvian" refers to the period before Noah's flood.[107]

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[102] Howard, *The Dawnseekers*, 190.
[103] In particular, in relation to dinosaurs W. T. J. Mitchell stated, "[t]here is no limit to the stories that can be made up about dinosaurs, and no limit to the ways of interpreting those stories."; W. J. T. Mitchell, *The Last Dinosaur Book: The Life and Times of a Cultural Icon* (Chicago, IL: University of Chicago Press, 1998), 48.
[104] Warren, *Explorations in the Dacota Country in the Year 1855*, 75.
[105] "Remains of Gigantic Antediluvians," *Scientific American*, June 15, 1878.
[106] Sternberg, *The Life of a Fossil Hunter*, 128.
[107] Preadamite fossil and antediluvian fossil were used as insults in the mid to late nineteenth century – referring to someone who is backward or old and often in political disputes. For example, see: *Daily Globe*, St. Paul, MN. February 17, 1881.; *The Daily State Journal*, Alexandria, VA, September 8, 1873.; *The Newport Miner*, NewPort WA, March 17, 1910.; Clark Kent, "Calendars and Poetic Fire," *The Fulton County News*, McConnellsburg, PA. June 16, 1910.; An example of an event that instigated the use of this term was the United States policy towards the Philippines in the late nineteenth century. It was used against those supposedly opposing progress.: *Bismarck Weekly Tribune*, May 05, 1899.; It was also in used in juxtaposition to progress and the railroads: *The Princeton Union*, February 13, 1878.

This was not an anomalous practice. Allying marine fossils with a large flood and incorporating them into a scriptural worldview had a long lineage in the western world's scientific tradition.[108] Scriptural geology was in the process of fading out of existence in serious scientific circles in the middle of the century. The foundational geologist that influenced Charles Darwin's theory of evolution through natural selection, Charles Lyell, was staunchly and successfully arguing against diluvial theories and scriptural geology in the early-to-mid nineteenth century.[109] However, scriptural geology's hold throughout the nineteenth century, even if simply embedded rhetorically in geological treatises and common reference, is undeniable.[110] Further proof comes from 1909 when Sternberg referred to the persistence of the six thousand-year age of the earth as it related to his early attempts at interpreting fossilized remains he found.[111] Given contemporary resistance to (or ignorance of) scientific theories such as the heliocentric model, the big bang, and evolution through natural selection, it is not difficult to believe that scriptural geology's hold on the popular and even scientific imagination had a far lengthier residence time.[112]

For some, the use of biblical terminology was literal, and for others it was simply rhetorical, analogical, or metaphorical. Regardless of its intention, the retention of terms from times past speaks to their explanatory power. It also opens up an avenue for misinterpretation. Another example comes from common terms used for dinosaurs.

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[108] Martin J. S. Rudwick, *The Meaning of Fossils: Episodes in the History of Paleontology* (Chicago, IL: University of Chicago Press, 1976), 68-95.
[109] Rudwick, *The Meaning of Fossils*, 135, 165, 174-175, 188.
[110] See Chapter 2.
[111] Sternberg, *The Life of a Fossil Hunter*, 3.
[112] Ian O'Neill, "1 in 4 Americans Don't Know Earth Orbits the Sun. Yes, Really," *Discovery News* 2014.; Michael Roppolo, "Americans Not Confident Big Bang or Evolution Is Real, Poll Shows," *CBS*, April 21, 2014.

Drawing from western science's presumed origins in the classical world, Cope's name for the mosasaur, *Pythonomorpha*, is derived from a gigantic serpent in Greek mythology.[113] Osborn's biography of Cope contained a section titled "Personal Reminiscences of the Paleontologist and Philosopher, 1877-1897," where he stated, "In the mean time, we had enjoyed our palaeontological baptism, not in the fossil dragon beds of Kansas but in the classic Bridger horizon of the Middle Eocene of Wyoming."[114] Marsh also could not help himself but to think of dinosaurs as dragons and sea serpents.[115] In his 1877 address to the AAAS, Marsh conjured the Cretaceous Sea and its monsters.

> The Reptiles most characteristic of our American Cretaceous strata are the *Mosasauria*, a group with very few representatives in other parts of the world. In our Cretaceous seas, they ruled supreme, as their numbers, size, and carnivorous habits, enabled them to easily vanquish all rivals…In the inland Cretaceous sea from which the Rocky Mountains were beginning to emerge, these ancient "Sea Serpents" abounded; and many were entombed in its muddy bottom.[116]

Without sanitizing science from the use of these terms, it is likely that they affected the manner in which the public understood the meaning of fossils. Even in the midst of rapid advances in American science, the public (and scientists) could still see scientific knowledge through the lenses of religion and mythology.[117]

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[113] Mayor, *Fossil Legends of the First Americans*, 213.
[114] Osborn, Warren, and Knight, *Cope: Master Naturalist*, 579-80.
[115] Newspapers likewise used this language in the nineteenth century. In fact, they still use it today. For examples, see: "Cretaceous Sea Serponts," *The Washington Post*, July 10, 1898.; "Genuine Sea Serpent," *The Washington Post*, June 18, 1899.; Evelyn Boswell, "Fossils from Ancient Sea Monster Found in Montana," *MSU News*, November 3, 2006.
[116] Marsh, "Introduction and Succession of Vertebrate Life in America," 14.
[117] For more information on the relationship between dragons and dinosaurs, see: Mitchell, *The Last Dinosaur Book*, 87-92.

The public did not have to rely on their imaginations to see these monsters as they read magazines and newspapers. Museums and public displays served to introduce American citizens to reconstructions of dinosaurs. The Crystal Palace at Sydenham in London that opened in 1854 was one of the first large-scale public displays of these long-extinct creatures. Its display of dinosaurs was designed as a story of biblically-infused progress culminating in Victorian civilization, but it provoked a range of responses from anxiety about materialism and the human place in nature and time to a merger of scripture and science.[118] This exhibition did not escape the attention of Americans who reacted similarly. For example, in the geological exhibit with its reproductions derived from "antediluvian fossils" a reporter from Richmond, Virginia remarked "will be seen the mastodon, the iguanidon, the peliosaurus, and other monsters, that from their vast size must have afforded capital hunting to the gigantic and godless contemporaries of Noah."[119] Around the same time, Americans tried to recreate the Crystal Palace in New York with mixed success.[120] After the Civil War, there was another attempt in Central Park, this time specifically focused on dinosaurs. However, this "Paleozoic Museum"

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[118] Geoffrey Cantor, "Science, Providence, and Progress at the Great Exhibition," *Isis* 103, no. 3 (2012): 439-459.; Nancy Rose Marshall, ""A Dim World, Where Monsters Dwell": The Spatial Time of the Sydenham Crystal Palace Dinosaur Park," *Victorian Studies* 49, no. 2 (2007): 286-301.; Samuel Phillips, *Crystal Palace: A Guide to the Palace & Park* (Crystal Palace Library: Bradbury & Evans, 1854), 157-163.; James A. Secord, *Monsters at the Crystal Palace,* in *Models: The Third Dimension of Science*, ed. Soraya de Chadarevian and Nick Hopwood (Stanford, CA: Stanford University Press, 2004), 138-169.
[119] "The Crystal Palace at Sydenham," *The Daily Dispatch*, Richmond, VA, June 16, 1854.
[120] Charles Hirschfeld, "America on Exhibition: The New York Crystal Palace," *American Quarterly* 9, no. 2 (1957): 101-116.; Robert C. Post, "Reflections of American Science and Technology at the New York Crystal Palace Exhibition of 1853," *Journal of American Studies* 17, no. 3 (1983): 337-356.

threatened the religious zeal of some of New York's powerful politicians and it was soon scrapped and the work done up to that point was literally buried.[121]

After the Civil War, American museums began to succeed as a result of increased public interest, unique fossil finds in the West, and wealthy patrons who had amassed amazing wealth through industrialization. The robber barons, less conflicted with the religious implications of dinosaurs, latched on to their supposed ferocious character in order to justify their social Darwinist ideologies and elevate their national pride.[122] Driven by public interest and private patronage, elaborate reconstructions were created in American museums for citizens to ponder.[123] Though, accurate scientific representation was crucial since errors, according to Marsh, were "very difficult to eradicate from the public mind."[124] For example, the implications of the following American Museum of Natural History visitors' guide definition of fossils should be considered in respect to

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[121] Edwin H. Colbert and Katharine Beneker, "The Paleozoic Museum in Central Park, or the Museum That Never Was," *Curator* 2 (1959): 137–150.; Adrian J. Desmond, "Central Park's Fragile Dinosaurs," Natural History 83 (1974): 65–71.; Paul Semonin, "Empire and Extinction: The Dinosaur as a Metaphor for Dominance in Prehistoric Nature," *Leonardo* 30, no. 3 (1997): 174.; "Twelfth Annual Report of the Board of Commissioners of the Central Park, for the Year Ending December 31, 1868," (New York: Evening Post Steam Presses, 1869), 129-144.; See also some news from the time that reported on the successes and failures of the Exhibition.: "The Crystal Palace," *The New York Times*. February 11, 1854.; "British View of the Crystal Palace," *The New York Daily Times*. March 20, 1854.; "The Crystal Palace Closed," *The New York Times*. November 1, 1854.

[122] For a great dissertation on the cultural and material capital of dinosaurs in late nineteenth and early twentieth century America, see: Lukas Benjamin Rieppel, "Dinosaurs: Assembling an Icon of Science," (PhD diss., Boston, MA: Harvard University, 2012).; See also: Mitchell, *The Last Dinosaur Book*, 143-144, 157-160.; Tom Rea, *Bone Wars: The Excavation and Celebrity of Andrew Carnegie's Dinosaur* (Pittsburgh, PA: University of Pittsburgh Press, 2001).; Semonin, "Empire and Extinction," 171, 174-176.; Jeremy Vetter, "Cowboys, Scientists, and Fossils: The Field Site and Local Collaboration in the American West," *Isis* 99, no. 2 (2008): 276.

[123] On the nature and cultural influences of the designs, see: Adrian J. Desmond, "Designing the Dinosaur: Richard Owen's Response to Robert Edmond Grant," *Isis* 70, no. 2 (1979): 224-234.; Lukas Rieppel, "Bringing Dinosaurs Back to Life: Exhibiting Prehistory at the American Museum of Natural History," *Isis* 103, no. 3 (2012): 460-490.

[124] Letter from Othniel Charles Marsh to Spencer Baird, December 20, 1875. Smithsonian Institution Archives. SIARU007002 Box 29 Folder 23. "Marsh, Othniel Charles, 1867-1885."; See also: Oliver P. Hay, "On the Restoration of Skeletons of Fossil Vertebrates," *Science* 30, no. 759 (1909): 93-95.

where many fossils were being found in the late nineteenth century – the arid American West. The Museum was considered by contemporaries as "A Great School of Science," where accuracy in geological labeling was paramount and provided the key to "unlock the geologic mysteries" of every state.[125] The guide defined fossils as "the remains of plants or animals that once lived in the ocean, or were washed from the land into the ocean."[126] This "error" or simplification of science could lead the public to believe that anywhere there were fossils, there was once an ocean.[127]

Fossils were also exhibited at World's Fairs. For example, in 1892 Lester Ward noted in his notebook that he was putting together a collection of Carboniferous fossils for what was presumably the 1893 World's Columbian Exposition.[128] This World's Fair, like the ones that followed, required institutions like the Smithsonian to purchase of fossils for display and the mount expeditions into the West for specimens to complete their exhibits.[129] Ward's fossils would have complemented the "full collection of the typical forms of American Paleozoic Crustacea special attention to be given to the larger

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[125] "A Great School of Science," *New York Times*, April 15, 1877.

[126] American Museum of Natural History, *Visitors' Guide to the Collections of Shells, Minerals, and Fossils in the American Museum of Natural History* (New York: Steam Printing House of Wm. C. Martin, 1885), 13.

[127] The state of geologic knowledge at this point in time did not support this singular view of fossil formation. See, for example see the following textbook from the well-known geologist Archibald Geikie where he explains the varied conditions under which fossilization can occur on land.: Archibald Geikie, *Text-Book of Geology* (London, Macmillan and Co., 1882), 603-606.

[128] November 15, 1892. "Note-book No. 6 of Lester F. Ward, October 1, 1892 to September 30, 1894," Smithsonian Institution Archives. SIA Acc. 07-041 Box 2, Folder 15. "Lester F. Ward, 4/1/1892-9/30/1892 + 10/1/1892-9/30/1894."

[129] For example, see a request for two to three hundred dollars to be set aside for preparing fossils and purchasing new specimens for the Columbian Exposition.: Letter from Prof. G. Brown Goode to Charles Walcott, September 5, 1891. SIARU70. Smithsonian Institution Archives. "Exposition Records, 1867-1939" Box 39 Folder 1. "Geological Exhibit, 1891-1893,"

specimens which have a greater popular interest."[130] The exhibit proposed for the 1901 Pan-American Exposition also contained a wealth of fossils. A Triceratops, Zeuglodon, Titanotherium from Marsh, Mastodon from Missouri, collection of not less than seven hundred ammonites and crinoids running along two-hundred-twenty feet of the display, and one-hundred-twenty feet of wall space dedicated to paleobotany including fossil wood.[131] Expositions like the Pan-American were also opportunities for the Smithsonian to purchase fossils from collectors for their museum.[132] As a show of nationalism, some specimens were even purchased from Europe in order to compare American fossils to those throughout the globe.[133] Also, once again, the American Mastodon was pursued into the West as the Smithsonian sent a collector out into what was then known as "Indian Territory" to investigate "reported finds of mastodon remains" to obtain for the Exposition.[134] Public display was a significant pathway for these paleo-treasures to make their way into the American mind.[135] Fossils, and the many stories that they could tell,

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[130] Note contained in Smithsonian Institution records of Columbian Exposition displays. Undated. SIARU70. Smithsonian Institution Archives. "Exposition Records, 1867-1939" Box 39 Folder 1. "Geological Exhibit, 1891-1893."

[131] "Mem. of Proposed Exhibit, DEPARTMENT OF GEOLOGY, At Pan-American Exposition, 1901," SIARU70. Smithsonian Institution Archives. "Exposition Records, 1867-1939" Box 56 Folder 8. "Merrill, George P., 1900-1901."

[132] Telegram to George P. Merrill, October 24, 1901. SIARU70. Smithsonian Institution Archives. "Exposition Records, 1867-1939" Box 56 Folder 8. "Merrill, George P., 1900-1901."

[133] Letter from George P. Merrill to Dr. True, December 18, 1900. SIARU70. Smithsonian Institution Archives. "Exposition Records, 1867-1939" Box 56 Folder 8. "Merrill, George P., 1900-1901."

[134] Letter from George P. Merrill to Dr. True, October, 3, 1900. SIARU70. Smithsonian Institution Archives. "Exposition Records, 1867-1939" Box 56 Folder 8. "Merrill, George P., 1900-1901."

[135] The Louisiana Purchase Exposition of 1904 also contained a wealth of fossils. The records for the Smithsonian's exhibit are quite detailed as to what was purchased domestically and internationally for display and how the exhibit was to be designed. Again, a collector was employed to secure additional fossils to complete their display.: SIARU70. Smithsonian Institution Archives. "Exposition Records, 1867-1939" Box 63 Folder 4. "Merrill, George P., 1903-1905."; For more information on World's Fairs and American culture, see: Robert W. Rydell, *All the World's a Fair: Visions of Empire at American International Expositions, 1876-1916* (Chicago, IL: University of Chicago Press, 1984).; Robert W. Rydell, *World of Fairs: The Century-of-Progress Expositions* (Chicago, IL: University of Chicago Press, 1993).; Robert W. Rydell, Nancy E. Gwinn, Smithsonian Institution Libraries, and James Burkhart Gilbert, *Fair*

were put to use for a variety of American ideologies and to justify social or cultural objectives.

These examples reveal the increasing interconnectedness of the West that drove the advancement of science and allowed the lay public to use elements of science to determine their own vision of the natural world as it reflected their social context. Laborers discovered the remains, locals interpreted their meaning, newspapers spread these initial conclusions to the nation on iron rails and via telegraph, and paleontologists ventured West on the growing transportation network to assess the early reports as to their accuracy. The scientific conclusions and specimens then travelled to eastern museums and institutions of learning on the same network that spread the first news and all the while the railroads were enabling and benefitting from the traffic that all of this activity required.

Railroad Cuts, Scientists, and Natural History Entrepreneurs

In many ways, the historical narrative of the development of the transcontinentals is also the story of the development of a distinct American science.[136] Railroad cuts provided glimpses into the earth that enabled paleontologists and geologists to study its

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Representations: World's Fairs and the Modern World. European Contributions to American Studies (Amsterdam: VU University Press, 1994).; Robert W. Rydell, John E. Findling, and Kimberly D. Pelle, *Fair America: World's Fairs in the United States* (Washington: Smithsonian Institution Press, 2000).; Smithsonian Institution Libraries and Robert W. Rydell. *The Books of the Fairs: Materials About World's Fairs, 1834-1916, in the Smithsonian Institution Libraries*. Smithsonian Institution Libraries Research Guide. (Chicago, IL: American Library Association, 1992).

[136] For discussions of the railroad's role in paleontology, see: Howard, *The Dawnseekers*, 178-191.; Thomson, *The Legacy of the Mastodon*, 168-176.; Jeremy Vetter, "Science Along the Railroad: Expanding Field Work in the Us Central West," *Annals of Science* 61, no. 2 (2004/04/01 2004): 187-211.

deep history.[137] The railroads provided routes that granted better access to fossil caches throughout the West and sparked public interest in the curious relics of deep time. The transportation corridors that they established granted greater access to scientists seeking to reach the rich paleontological sites of the West. The railroads also provided a pool of prospectors for paleontologists as railroad workers and settlers participated in the study of deep time and engaged in collection for earth scientists and for public sale. Field scientists and the transcontinental railroads enjoyed a reciprocal relationship that ensured that American science would advance as rapidly as the settlement of the western frontier in the late nineteenth century. The building of the transcontinentals and the intricate rail networks of the West spurred the location of fossils through railroad cuts and construction, sped access to fossil lands through expanding rail lines, and gave railroad workers critical local knowledge that they passed on to scientists studying the earth.

The railroads were opening up a new world in the West. It was a world that stretched horizontally across the nation and vertically into the depths of the earth and time itself. The railroads helped to change our conception of time in more than one way. As they were conquering space, they were inadvertently helping to deepen the earth's history. May 10, 1869 was an important day not only for homesteaders and miners, but also for earth scientists because it was the day of the linking of the Central Pacific and the

[137] Other utilitarian practices that dug into the earth also revealed the geological history of North America. Some of these even made it to press. For example, an 1877 article explained what was revealed by the boring of a well in St. Louis, Missouri for an "insane asylum." After explaining what the boring revealed regarding fossil fuels and useful metals in the region, the article concluded, "[t]he fossils tell us that the nautilus and ammonite were the only sails then seen; that these early voyagers its compeer then on the waves of this Silurian sea did hail."; "Geology of the West. What Was Suggested by the Boring of an Artesian Well for the Insane Asylum at St. Louis," *New York Times*, August 2, 1877.

Union Pacific railroads.[138] Not only was the nation united, the world of the earth sciences was opened to the public. For example, until the Union Pacific route was straightened, the Como Bluffs, Wyoming fossil dig was visible from the railroad and the bone hunters were greeted by waving passengers as they rode on by.[139]

The West was becoming increasingly populated by the late nineteenth-century. For example, Wyoming jumped from 9,118 people in 1870 to 62,555 in 1890, Colorado soared from 39,864 people in 1870 to 413,249 in 1890, and Kansas exploded from 364,399 people in 1870 to 1,428,108 in 1890.[140] Because there were increasing numbers of people situated close to the tracks and therefore close to the fossil dig sites, more individuals in this formerly lush environment were taking advantage of the spoils of deep time through ease of travel by means of fossil fuels and expanding markets for fossils, which earned locals a few extra dollars.[141] Railroad construction, coal mining, and settlement in the West influenced the location of fossils through railroad cuts and construction, and enhanced the access granted to fossil lands through expanding transcontinental lines.[142]

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[138] Thomson, *The Legacy of the Mastodon*, 172.
[139] Thomson, *The Legacy of the Mastodon*, 172.
[140] U.S. Census Bureau, "Resident Population and Apportionment of the U.S. House of Representatives: Wyoming," http://www.census.gov/dmd/www/resapport/states/wyoming.pdf.; U.S. Census Bureau, "Resident Population and Apportionment of the U.S. House of Representatives: Colorado," https://www.census.gov/dmd/www/resapport/states/colorado.pdf.; U.S. Census Bureau, "Resident Population and Apportionment of the U.S. House of Representatives: Kansas," http://www.census.gov/dmd/www/resapport/states/kansas.pdf.
[141] Thomson, *The Legacy of the Mastodon*, 293-294.
[142] Goetzmann, *Exploration and Empire*, 497.; Thomson, *The Legacy of the Mastodon*, 6, 172.; Examples include.: Leo Lesquereux, "Contributions to the Fossil Flora of the Western Territories: Part I. The Cretaceous Flora," in Ferdinand Vandeveer Hayden, *Report of the United States Geological Survey of the Territories VI*, (Washington: Government Printing Office, 1874), 12, 20.; Charles Hazelius Sternberg, *The Life of a Fossil Hunter* (New York: Henry Holt and Company, 1909), 267.; George Reber Wieland Papers. Manuscripts and Archives, Yale University Library. Series II. Box. 5. Folder 33. Notebook of the 20th Geological Excursion 1898.

Inadvertently, the railroads unfurled the pages of deep time for paleontologists in the western field.[143] Today, highway cuts serve a similar purpose for geologists who see them as John McPhee has stated, "windows into the world as it was in other times."[144] For paleontologists, these windows provided access to the material remains of the past that helped construct their visions of former worlds. The geologist and surveyor, Hayden remarked in the fourth USGS survey that, "[t]he geologist is dependent for his knowledge of the earth's crust, either on natural sections formed by the channels of rivers, or the upheavals of mountain chains, or the artificial cuts along railways, or artesian borings."[145] Enacting similar effects on the earth, either nature or the railroads granted access to pages of deep time. Hayden continued by artfully stating, "[t]he cuts along the line of the railroad are, as it were, slices in the earth's crust which often reveal the nature of the underlying formations with wonderful clearness, throwing a flood of light upon obscure points."[146] While following the "belt of country bordering the line of the Union Pacific Railroad…Along a well-known line of travel," Hayden considered that "the attention of the student of geology will most likely be attracted toward the principal geological features, and on this account I hope to make the succeeding chapters a sort of guide in this respect."[147] While travelling and making his observations along the line from "Bear River to Great Salt Lake Valley" he made a fruitful find by virtue of the railroad's cut:

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[143] Vetter, "Science Along the Railroad: Expanding Field Work in the Us Central West," 200-201.
[144] John McPhee, *Annals of the Former World*, 1st ed. (New York: Farrar, Straus and Giroux, 1998), 36.
[145] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 85.
[146] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 85.
[147] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 85.

> along no other portion of our route have I ever seen so rich a locality of fossil shells, of a few species. In the cut and on the hills on either side of Bear River the ground is literally paved with them, and the collector may gather them as he would the shells on the seashore.[148]

Hayden's journey along the Union Pacific Railroad brought him to rich scientific finds exposed by the railroad. Through the window into the earth created by the railroad cut, the fossil shell cache he marveled at along the rail line conjured images of the sea, although "[e]ven the most enthusiastic of our companions in travel will not hesitate to pronounce it a desert."[149] The railroads gave him access to this former world and he was able to see its plasticity through the material exposed by the nation's expanding rail network.

Hayden sought to educate the public about western geology with his surveys. "Along a well-known line of travel," he wrote in 1872, "the attention of the student of geology will most likely be attracted toward the principal geological features, and on this account I hope to make the succeeding chapters a sort of guide in this respect."[150] The utility of railroad cuts to geology was so evident that there was even a railway guide created for those interested in the geological wonders they could see along their trip through their train window. Former commissioner of the second geological survey of Pennsylvania James Macfarlane's 1879 work, *The Geologist's Traveling Hand-Book: An American Geological Railway Guide, Giving the Geological Formation at Every Railway Station, with Notes on Interesting Places on the Routes, and a Description of Each of the*

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[148] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming,* 149-150.
[149] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming,* 147.
[150] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming,* 85.

Formations, is in many ways similar to the roadside geology manuals that are sold today.[151] The text was primarily intended for non-geologists.

> In these railway journeys no person who has the least power of observation can fail to notice the peculiarities in the scenery and the great variety of formations of rock to be seen in the railway cuts and cropping out on the hillsides. . .One object of the work is to teach persons not versed in geology something of this science during the tedious and unprofitable hours of traveling, without study, not as in a text book, but by pointing to the things themselves as seen at railway stations and through the windows of a railway car.
>
> No person could be so stupid as to travel all over the United States without learning the name of a single state or city through which he passes, yet how few persons know even the names of the geological formations on which they have spent their lives.[152]

However, the author was clear that this guide was not to be simply limited to lay readers. "[N]o geologist," according to Macfarlane, "should make an excursion over new ground without this guide."[153] Macfarlane even included another segment of readership that would benefit from his book – the "utilitarian."

> To those who take only utilitarian views and care nothing for pure science, and to all those in any way interested in the country, a means is here furnished for ascertaining the natural advantages or disadvantages of any district where there is a railroad, for it is now pretty well known to all intelligent persons that the capabilities or resources of a

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[151] For examples of contemporary roadside geology texts, see: David D. Alt and Donald W. Hyndman, *Roadside Geology of Montana* (Missoula, MT: Mountain Press Pub. Co., 1986).; Will Fritz, *Roadside Geology of the Yellowstone Country*, Roadside Geology Series (Missoula, MT: Mountain Press Pub. Co., 1985).; David R. Lageson and Darwin Spearing, *Roadside Geology of Wyoming*, Rev. 2nd ed., Roadside Geology Series (Missoula, MT: Mountain Press, 1991).

[152] James Macfarlane, *The Geologist's Traveling Hand-Book: An American Geological Railway Guide, Giving the Geological Formation at Every Railway Station, with Notes on Interesting Places on the Routes, and a Description of Each of the Formations* (New York: D. Appleton and Company, 1879), 3.

[153] Macfarlane, *The Geologist's Traveling Hand-Book*, 4.

> country, what it is and what it can become, depend chiefly on its geology.[154]

Fossils were largely absent from this guide, but owing to the utilitarian angle of the author, there are references to the economic use of fossils in identifying strata and discussions of items of industrial concern such as coal deposits.[155] Macfarlane was not unaware of how large a role fossils played the assessment of coal seams.[156] He even quoted from a Canadian geologist who proclaimed fossils to be "the geologists' friends, who direct him in the way to what is valuable."[157] Yet, Macfarlane knew that paleontologists would not appreciate his coverage since he believed that "paleontology is not the whole of geology, and that formations are more than a mere cabinet of fossils."[158] Even if he belittled the work of many paleontologists, Macfarlane was not ignorant to the many ways in which fossils supported the development of the West.

The railroad cuts that revealed ages lost to time to railroad passengers also exposed many fossil caches for western field scientists. Paleontologists and fossil hunters were regularly taking advantage of the work performed by the railroads in revealing the relics of the deep past. Many of the men mentioned in previous chapters used these cuts to lend a hand in their collecting. Lakes gave credit to Union Pacific Railroad cuts for displaying the strata of the earth and revealing its history.[159] Likewise, in the early 1870s, Marsh noted in his pocket notebook, "At Rock Creek (620 post) U.P.R.R. west of

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[154] Macfarlane, *The Geologist's Traveling Hand-Book*, 5.
[155] Macfarlane, *The Geologist's Traveling Hand-Book*, 5, 39-40, 44.
[156] Macfarlane also wrote a text on coal in America where he seems to understand the significance of fossils to the study of coal geology. Indeed the fossils found in coal led him to believe that while coal was being formed there was a universal climate across the globe.; James Macfarlane, *The Coal-Regions of America: Their Topography, Geology, and Development* (New York: D. Appleton and Company, 1873), 611.
[157] Macfarlane, *The Geologist's Traveling Hand-Book*, 5.
[158] Macfarlane, *The Geologist's Traveling Hand-Book*, 48.
[159] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 149.

Laramie fine cretaceous fossils. U.R.R. cut."[160] In the late nineteenth and early twentieth centuries, paleontologists Henry Fairfield Osborn and Barnum Brown also made note of their use of railroad cuts in understanding the local geology and in drawing stratigraphic sections.[161] The fossil hunter Charles H. Sternberg obtained "two noble specimens of the Pleistocene Age" from a pair of men in Kansas in 1908. The specimens were:

> uncovered through a fortunate chance. It seems that the Missouri Pacific Railway, wishing to shorten the creek in the vicinity of Hoxie, Sheridan County, Kansas, cut a new right-of-way for it across a bend. Their excavation came within two feet of the bones buried below, thirty-five feet from the surface of the earth; a friendly freshet washed them out, and they were discovered by Mr. Frank Lee and Harley Henderson, of Hoxie, Kansas, June 15, 1902.[162]

Not only did Sternberg call upon some local collectors to obtain specimens, but he was indirectly taking advantage of this deep railroad cut as late as 1908. This also demonstrates the fact, discussed in Chapter 5, that people besides paleontologists and fossil hunters employed by paleontologists were interested in these relics of deep time.

Also, while they may not have been paleontologists, observant railroad passengers who passed through Green River Depot in Wyoming could not have missed the plethora of petrified remains relegated to the rocks and extracted to be sold to passengers.[163] The

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[160] Othniel Charles Marsh, Pocket Notebook 4, 1870s, Yale Peabody Museum of Natural History, Vertebrate Paleontology, West Campus Archives, Yale University (New Haven, CT).
[161] Henry Fairfield Osborn, "Field Notes: Excursions of 1897" in *Archival Field Notebooks of Paleontological Expeditions*: American Museum of Natural History Paleontology Division. http://research.amnh.org/paleontology/notebooks/osborn-1897/00.html.; Barnum Brown, "Field Book: 1908, 1910, 1911, Barnum Brown: Late Cretaceous Alberta - Montana," in *Archival Field Notebooks of Paleontological Expeditions*: American Museum of Natural History Paleontology Division. http://research.amnh.org/paleontology/notebooks/brown-1908-11/.
[162] Sternberg, *The Life of a Fossil Hunter*, 267.
[163] Lance Grande, "Paleontology of the Green River Formation, with a Review of the Fish Fauna," ed. The Geological Survey of Wyoming, Bulletin 63, Second Edition (Laramie, WY: 1980).; Robert West, "Vertebrate Paleontology of the Green River Basin, Wyoming, 1840-1910," *Earth Sciences History* 9, no. 1 (1990).; Howard, *The Dawnseekers*, 53, 178, 188, 189, 244-245, 268, 277-278, 287.

fourth, fifth, and sixth USGS reports repeatedly reference this region. In the fourth USGS survey, Hayden described the area as follows:

> About two miles west of the station there is an excavation which has been called the Petrified Fish Cut, on account of the thousands of beautiful and perfect impressions of fishes which are shown on the surface of the thin slabs, sometimes a dozen or two on an area of a square foot. Impressions of insects and water plants are also found, as well as of a remarkable specimen of a feather of a bird, which Professor Marsh regards as a unique specimen, forming a most interesting addition to the bird remains of North America…My collection of fossil fishes from this cut is very large, and my success was mostly due to the kind aid of Mr. A.W. Hilliard, a gentleman of intelligence, who superintended the excavation along the line of the road, and preserved from time to time such specimens of value as came his way. If the example of Mr. Hilliard had been imitated all along the line of this railway thousands of most valuable specimens would have been preserved which are now lost to science.[164]

Hayden's commentary above shows how rich this fossil bed was and how close to the rail line it sat. While he applauded the enlightened Mr. Hilliard, he lamented the laziness of other railroad men who likely uncovered scientific specimens from deep time in the process of their work in producing cuts and digging wells and simply ignored or destroyed these treasures of the earth. [165] Interested railroad men also contributed to the advance of American science in the West.

In the fifth USGS report, Professor Joseph Leidy authored a section titled "On the Fossil Vertebrates of the Early Tertiary Formation of Wyoming," in which he described fossil finds in the Green River Basin of Wyoming. In this section, Leidy's examination

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[164] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 142-143.

[165] In the same report, the specialist in vertebrate paleontology E. D. Cope wrote a chapter in which he described the "Fishes of the Tertiary Shales of Green River, Wyoming Territory."; Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 425-431.

delved into the history of the paleontological finds in the region, used florid language in his descriptions of the finds, and he referred to the Green River railroad cut that appealed to Hayden's curiosity. A number of items relevant to this analysis leap out from Leidy's report. The first is the ranking of the interest of the Green River in relation to other fossil caches in the West. Leidy referenced the formations of the Green River as potentially more important than the fossil rich Bad Lands and the Niobrara River of Nebraska where the fossil wealth of James Cook's Ranch was situated. The next item is of particular interest are the cluster of dates where major finds in this region tended to occur. There is a sudden surge in exploration and discovery in the period surrounding the completion of the first transcontinental railroad in 1869. This demonstrates the significance of the railroads in advancing scientific knowledge of the West. Also, we once again see doctors as amateur paleontologists playing a prominent role in the early days of paleontology in the American West. Lastly, Leidy reported on the profusion of petrified ichthyological remains revealed by the railroad. In this arid land, fish were swimming in the rocks. Sailing across the West, the wake of the railroads washed up their remains. [166]

It was thought that the Green River Station may also hold the potential energy to restore elements of those ancient environments and stimulate settlement. In the sixth USGS report, Leo Lesquereux's report on "Lignitic Formation and Fossil Flora" contained a section on these prospects for the Green River Station. His analysis differed from the above descriptions of the paleontological specimens in the Green River region because his aim was to understand the fossil fuel potential of the area. The seeming

[166] Ferdinand Vandeveer Hayden, *Preliminary Report of the United States Geological Survey of Montana, and Portions of Adjacent Territories; Being a Fifth Annual Report of Progress for the Year 1871* (U.S. Government Printing Office, 1872), 353-372.

appearance of coal-like strata, according to Lesquereux, "has caused a great deal of useless researches, borings, and tunnelings, from unreliable reports on the presence of true coal at various localities around Green River Station."[167] The fact that the location was a rail station no doubt prompted prodigious explorations for the use of fuel for local settlements and the locomotives steaming through the station. Nonetheless, Lesquereux held a dim assessment of the area's coal prospects. He noted, "[f]rom my own exploration of these formations, I am satisfied that they do not have any bed of true lignite." Lesquereux found that "[t]he shales are, however, valuable, and may yield by distillation an amount of bitumen large enough to be remunerative, when this matter becomes available to some purpose in the distant localities where it is found." The peculiar source of this bitumen appeared to Lesquereux "to be essentially the result of the decomposition of animal matter." The Green River region was once an area of abundant fresh-water lakes and "[t]hese lakes were inhabited by a prodigious quantity of fishes, which, destroyed at repeated periods by drought, have partially furnished the bitumen to the shales where their skeletons are preserved." The fish remains were everywhere, and Lesquereux "scarcely failed to find traces of fish remains in the numerous beds of bituminous shale" that he examined.[168] These fish remains were not only useful for the science of paleontology and for curious railroad passengers, but also in theory for the future of the region as a source of energy.

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[167] Ferdinand Vandeveer Hayden, *Sixth Annual Report of the United States Geological Survey of the Territories: Embracing Portions of Montana, Idaho, Wyoming, and Utah; Being a Report of Progress of the Explorations for the Year 1872* (U.S. Government Printing Office, 1873), 337.
[168] *Hayden, Sixth Annual Report of the United States Geological Survey of the Territories,* 337.

The growing rail system and trends in home décor favoring natural history curios also yielded large markets where specimen dealers and aspiring naturalists could become entrepreneurs.[169] News of fossil discoveries traveled far and fast, prompting rushes to sites along the railroads.[170] The Green River Depot, "Fossil Fish Cut," or "Petrified Fish Cut," serves as a prime example of this fossil phenomenon. Homesteaders in the region took advantage of these markets and blasted and sawed fossils from the deep past.[171] For example, soon after fossils in the Green River region of Wyoming were identified in the late nineteenth century by Hayden, Cope, and Marsh, the Green River City depot became a thriving market for fossils, which Gilbert F. Stucker reported:

> A variety of destinies awaited these fish, once they were exhumed. As curio items, they gave rise to a lively local trade, with the not-too-distant railroad station at Green River serving as principal outlet. Specimens brought from fifty cents to a dollar apiece on the platform. As business prospered, prices increased and were adjusted to the buying power of the traveling public. Tourist-car passengers had a choice of the common *Knightias* for $1.50 to $3.00, or "Sunfish" for slightly more. Holders of Pullman tickets were shown the larger, deep-bodied varieties which fetched $15 to $35, while stateroom customers were offered the "museum pieces," valued at a hundred dollars.[172]

The local market that developed for these specimens shows that they were quite popular with the travelling public and widely abundant for amateur prospectors to excavate in the vicinity of the railroad cut.[173] The ancient watery world in which these fish flourished

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[169] Barrow, "The Specimen Dealer…", 494, 496, 502.
[170] Howard, *The Dawnseekers*, 178-179.
[171] Howard, *The Dawnseekers*, 189.; Katherine Rogers, *The Sternberg Fossil Hunters: A Dinosaur Dynasty* (Missoula, MT: Mountain Press Publishing Company, 1991),107.; Thomson, *The Legacy of the Mastodon*, 293-294.
[172] Gilbert F. Stucker, "Mountain of the Stone Fishes," *National Parks* (September 1966), 5-6.
[173] Another example comes from the published letters of a post surgeon's wife who visited the Green River area in May of 1879. She noted that the innkeeper had a number of fossil fish from the area and that she

affected the history of this nineteenth-century rail station and the lives of those living near the Union Pacific line. Once purchased by tourists and travelers, the fish found themselves swimming through the imaginations of their keepers as they rode through the dusty desert lands of southern Wyoming [Figure 46].[174]

Many of these fossil hunters were involved in the "*bone business,*" as Marsh's "western friends call it." Remarkably, according to Wyckoff in 1875, the interest in fossil specimens was so robust that the financial difficulties surrounding the Panic of 1873 "did not slaken" the demand.[175] The bone business was made profitable in part through patronage by the feuding Cope and Marsh who raised the cost of doing paleontological fieldwork in the West. But it was also made profitable through the public interest in natural history curiosities such as fossils and other wealthy institutional patrons such as Andrew Carnegie.[176] There were also some who took advantage of this economic opportunity and used their interest in the natural world to become entrepreneurial examiners of the earth who sold specimens to private collectors and scientific institutions.[177] For example, Sternberg's prerogative was to sell to paleontologists rather

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would try to get some as well when she made it closer to the cut.: Thomas R. Bueker, "Letters from a Post Surgeon's Wife," *Annals of Wyoming: The Wyoming History Journal* 53, no. 1 (1981): 48.; See also references to sales of these fossil fish in the Union Pacific's 1899 pamphlet "Some of Wyoming's Vertebrate Fossils.": Union Pacific Railroad Passenger Department, "Some of Wyoming's Vertebrate Fossils," (1899), 29.

[174] Hayden noted the Green River formation in his *The Great West* as an attraction for someone travelling by train.: Ferdinand Vandeveer Hayden, *The Great West: Its Attractions and Resources. Containing a Popular Description of the Marvellous Scenery, Physical Geography, Fossils, and Glaciers of This Wonderful Region; and the Recent Explorations in the Yellowstone Park, "the Wonderland of America," by Prof. F.V. Hayden, LL.D., Formerly United States Geologist. Also, Valuable Information to Travellers and Settlers Concerning Climate, Health, Mining, Husbandry, Education, the Indians, Mormonism, the Chinese; with the Homestead, Pre-Emption, Land, and Mining Laws. By a Corps of Able Contributors. Handsomely Illustrated with Engravings and Maps* (Bloomington, IL: Charles R. Brodix, 1880), 89.

[175] Wyckoff, "A Perilous Fossil Hunt," 258.

[176] Rea, *Bone Wars*, 1-11, 198-206.

[177] Barrow, "The Specimen Dealer…", 497.

than showmen or dealers who would have marked up the price of these specimens by at least fifty percent.[178]

Not all of this public interest served science proper. Collection in the name of science was not the only motivation prompting a harvest of the fossils in this location. Fossil hunters and paleontologists regularly encountered evidence of public plunder of rich fossil localities. "They [the Petrified Stumps] average from twelve to fifteen feed in diameter and are said to have stood at one time twenty to thirty feet above the ground," Arthur Lakes explained, "till vandals from Chicago came and carted some away and other vandals of visitors cut them down to their present level."[179] The location of this plunder was known as the Florissant Fossil Beds in Florissant, Colorado, which became a National Monument in 1969.[180] Interest in these curiosities drove many entrepreneurs looking to profit from a national market for fossil specimens, visitors looking for souvenirs, and locals looking to decorate their homes, to chip away at the wealth of this fossil locality.[181]

Natural history entrepreneurship was not, however, always the most profitable and stable profession. In 1899, Ed. Rosseau, who had "a family of halfbreed children,"

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[178] Sternberg, *The Life of a Fossil Hunter*, 31.; The buying of fossils from Americans and Europeans, like with the purchase of fossils for World's Fairs, was a regular occurrence for paleontologists and institutions like the Smithsonian.: Letter from Spencer Baird to Robert Kettle Esq. Fremont, Nebraska, March 18, 1878, Smithsonian Institution Archives. RU53, Microfilm Vol. 22, Reel 21.; August 22, 1895. "Note-book No. 8 of Lester F. Ward: July 1, 1895 to December 31, 1896," Smithsonian Institution Archives. SIA Acc. 07-041 Box 2. "Lester F. Ward 7/1/1895-12/31/1896 + 1/2/1897 – 12/29/1898."; Letter from Charles H. Sternberg to Mr. J. W. Gidley of the National Museum, February 5, 1912. Smithsonian Institution Archives. "Vertebrate Paleontology 1889-1957." SIARU000156 Box 13 Folder 23. "Sternberg – Stinton."; There were also individuals like Henry A. Ward who helped supply museums with natural history specimens.: (Sally Gregory Kohlstedt, "Henry A. Ward: The Merchant Naturalist and American Museum Development," *Journal for the Society for the Bibliography of Natural History* 9, no. 4 (1980): 647-661.)
[179] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 52.
[180] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 173-174.
[181] Lakes, Kohl, and McIntosh, *Discovering Dinosaurs in the Old West*, 173.

and whose "only means of gaining a livelihood…[was] gathering bones upon the prairie and shipping them over your [James Hill and the Great Northern Railway] road" had bad luck in losing a large portion of his cache to a train car that prematurely left the tracks. Fortunately Rosseau was assisted in his case by a North Dakota attorney. The attorney informed Hill, besides losing "his winter supply of the necessaries of life for himself and family, and there is a family of nine children," and the fruit of "all summer gathering bones," Rosseau was over-charged for the weight of the bones he was able to load. The attorney pleaded directly to Hill "out of regular channel" and asked him "out of the goodness of your heart" to provide "relief for this poor person under the rules as established by the company."[182] Whether or not Hill's heart actually proved good enough to grant Rosseau's request is unclear, but this exchange indicates that there was a market for natural history specimens from the West to be shipped to consumers via the national rail network. It also shows that if one were to fail in homesteading in the West, the public demand for natural history curios would allow the piecing together a living through natural history specimen collection.[183] The profession of fossil hunters described in previous chapters significantly contributed to this market.

The railroads ripped open the West. They enabled the region to be settled rapidly and they cut deep into the earth and revealed its history. Space and time had been conquered by this technology at the same time that the West's geological history was unveiled to scientists and the public. Americans had an interest in natural history and in the context of this fast-paced life they were encouraged to see a condensed course of

[182] Letter from W. J. Anderson to James J. Hill; 132.E.9.9; Great Northern Railway Company Records. Minnesota Historical Society.
[183] Barrow, "The Specimen Dealer…", 502.

progressive history through science and the powers released by technologies fueled by coal. The railroads were partners in science and in the development of the West. It should not be surprising that these two enterprises worked synergistically to boost for the region's future.

Boosting the West through its Deep Past

The American transcontinental railroads and western boosters had a symbiotic relationship with the advancement and popularization of geology and paleontology in America. Public interest and participation with fossil prospecting in the West was intimately tied to the networks of transportation that enabled settlers and scientists to access the frontier. The growing transcontinentals expedited news of discoveries to the general public through correspondents in the West who used the rails and telegraph wires to connect news of the West with the wider world. The development of the transcontinental railroads assisted in the development of scientific knowledge and broadening the popularity of paleontology.

Boosters, who often worked for the railroads, used geological and paleontological knowledge in their writings because it was popular with the lay public who would read their publications. Boosters also benefited from the use of paleontological and geological knowledge because it helped to demonstrate the plasticity the lands that heretofore had a bad reputation for their inhospitable nature. The lands of the West had been far more verdant in the past, and could therefore have a hospitable future for migrants seeking to settle the abundant western lands. Also, railroads like the Union Pacific would sponsor expeditions to study western geology. In part this last motivation was self-serving since

the western railroads came to rely on the fossilized fertility of the deep past – coal. Paleontology was an essential complement to the study of coal geology because it provided the knowledge of fossilized organisms that served as markers for the existence of fossil fuels. It was also advantageous for the railroads since sponsoring a scientific expedition attracted attention and was good advertising to a public interested in natural history. This section will demonstrate the boosting work of the Kansas Pacific Railroad's William E. Webb, the Northern Pacific Railroad, and the Union Pacific Railroad that utilized the West's geologic history to promote its settlement potential and to advertise for the enlightened nature of their lines.

Relationships between scientists and locals in the West were also often based in reciprocity and sometimes those locals were linked to the railroads. Paleontologists not only contributed financially to the lives of locals by purchasing specimens, they also assisted in their efforts to boost for their region's development. Cope's relationship with a land office agent of the Kansas Pacific Railroad by the name of William E. Webb was just such a mutually beneficial bond.[184] Webb was a man of the industrializing West. He traveled, shot buffalo with and wrote about Buffalo Bill, and even undermined a speculative land endeavor of Cody's with his own ambitious town-siting plans.[185] Webb, was also an interested amateur paleontologist and was communicating with credentialed paleontologists since at least 1868 and providing them with evidence of the Cretaceous in

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[184] William E. Webb, *Buffalo Land: An Authentic Account of the Discoveries, Adventures, and Mishaps of a Scientific and Sporting Party in the Wild West* (Chicago, IL: E. Hannaford & Company, 1872).; Jane P. Davidson, "Edward Drinker Cope, Professor Paleozoic and 'Buffalo Land,'" *Transactions of the Kansas Academy of Science* 106, No. 3/4 (Autumn, 2003): 177.; Webb cooperated with Edward Drinker Cope and Joseph Leidy in finding fossils. For a discussion of Webb and his publication also see: Thomson, *The Legacy of the Mastodon*, 153, 202-210.

[185] Warren, *Buffalo Bill's America*, 27, 50, 132, 158; Thomson, *The Legacy of the Mastodon*, 203.

Kansas.[186] Writing from Kansas, Cope noted in a letter to his sister on September 7, 1871:

> The air is delightful, and it is impossible not to be taken with the spirit of the push for the West. The plains are said to be alive with buffalo, so much so as to stop the trains on the 'K.F.' I will only remain out here a short time at present, but will come out in the II mo. and spend a month on a special expedition with Webb to combine fossils and land business. Such an opportunity is very fine with a man who knows the ground. Prof. Marsh has been in that country for three weeks but has no such chance as I.[187]

Cope was heady with the prospects of Manifest Destiny and with his upper hand in the Bone Wars. His willing assistant, the railroad agent Webb, promised to help him find fossils and prospect for valuable property in the West. Cope's hopes for a fecund fossil foray were soon confirmed and a few days later he wrote to his wife that, "[i]t appears that the whole fossil reptiles and fishes are legion, out there, that the whole country is filled with them. That one has only to go after them to obtain them."[188] Cope's use of Webb as a source of local fossil knowledge is evident in the fourth and fifth USGS reports. In the fourth USGS report published in 1872, Cope wrote, "A specimen of *Mosasaurus missuriensis* obtained by William Webb near Topeka is stated by him to measure seventy-five feet in length."[189] In the fifth USGS report published later in 1872, Cope wrote, "William E. Webb, of Topeka, discovered the specimens from which this species was first described, and liberally forwarded them to me for examination and

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[186] Adrienne Mayor, *Fossil Legends of the First Americans* (Princeton, NJ: Princeton University Press, 2005), 178.
[187] Henry Fairfield Osborn, Helen Ann Warren, and Charles Robert Knight, *Cope: Master Naturalist; the Life and Letters of Edward Drinker Cope, with a Bibliography of His Writings Classified by Subject; a Study of the Pioneer and Foundation Periods of Vertebrate Palaeontology in America* (Princeton, NJ: Princeton University Press, 1931), 161.
[188] Osborn, Warren, and Knight, *Cope: Master Naturalist*, 162.
[189] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 386.

description."[190] Webb served as an excellent source of local fossil knowledge and as an amateur collector of fossils.

This relationship was not a one-way street. Webb used geological and paleontological knowledge that he gained from Cope to create his 1872 booster tract, *Buffalo Land: An Authentic Account of the Discoveries, Adventures, and Mishaps of a Scientific and Sporting Party in the Wild West*.[191] In a section titled "A Chat with Professor Cope," Webb used direct passages from Cope's vivid paleo-environmental imagination that later appeared in the fifth USGS report.[192] As mentioned above, Webb was a land office agent for the Kansas Pacific Railroad and he intended his book as an educational piece of railroad propaganda. He performed the role of a booster for the West and provided appendices that spoke to the abundance and habitability of the region and quoted from material that would later find itself in the fourth USGS report.[193]

For instance, "[o]f the question of fuel for the future dwellers upon the face of Buffalo Land," Webb directly extracted a statement from the Hayden in the Wyoming report that explained, "in the vicinity of the Rocky Mountains, in Wyoming, and Colorado, coal in immense quantities has been hidden away for ages, and the Union

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[190] Hayden, *Preliminary Report of the United States Geological Survey of Montana*, 336.

[191] Other boosters were guilty of fabricating tales of the West, Webb notes, but his publication was informed by the "valuable surveys being made from time to time under the auspices of the government.": Webb, *Buffalo Land*, 468.; However, Webb was not alone in using the West's geology as a featured element in booster literature. Gilpin, as described above, was another example. For more examples, see: John Wesley Clampitt, *Echoes from the Rocky Mountains; Reminiscences and Thrilling Incidents of the Romantic and Golden Age of the Great West, with a Graphic Account of Its Discovery, Settlement, and Grand Development* (New York: Belford, Clarke, 1889), 179-182, 634-635.; George W. Pine, *Beyond the West: Containing an Account of Two Years' Travel in That Other Half of Our Great Continent Far Beyond the Old West, on the Plains, in the Rocky Mountains, and Picturesque Parks of Colorado* Fourth Edition (Buffalo, NY: Baker, Jones & Co., 1873), 77, 78, 81-82.

[192] Davidson, "Edward Drinker Cope, Professor Paleozoic and 'Buffalo Land,'" 177-191.; Webb, *Buffalo Land*, 338-346, 353-362.

[193] Davidson, "Edward Drinker Cope, Professor Paleozoic and 'Buffalo Land,'" 177.; Webb, *Buffalo Land*, 469.

Pacific Railroad has now brought it near the door of every man's dwelling."[194] Hayden's encouraging comments concerning coal and the imaginative journeys of Cope were coupled directly to freely available USGS documents and to popular tracts like *Buffalo Land* that served to broaden their transmission to the American public and boost the West. Visions of the deep past were ferried from the sphere of science to a broader social sphere as knowledge of the paleontology and geology of the West breached the popular consciousness.[195] Webb used these government documents, his own fossil hunting experience, and his friendship with Cope to inform the vision of the past and future of the West that infused *Buffalo Land*.

The protagonist of the story, likely based on Cope, was "Professor Paleozoic" a "worthy man, vastly more troubled with rocks on the brain than 'rocks' in the pocket," and a "geological authority of the highest order."[196] The "scientific and sporting party" relied not only on the abundant knowledge of Professor Paleozoic, but also on the locals that they encountered in the field. For example, Louis "a wiry little Gaul" the party found skinning a wolf, directed Professor Paleozoic to a fossil cache in the vicinity of Sheridan Wyoming that contained "a *Mosasaurus*, a huge reptile which existed in the cretaceous

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[194] Webb, *Buffalo Land,* 486-487.; Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 101.; Interestingly, quoting from Hayden here he also refutes the position that "[m]any people have taken…that the Creator never mad such a a vast country, with a soil of such wonderful fertility, and rendered it so suitable for the abode of man, without storing in the earth beds of carbon for his needs." The fact that he had to take time to address this misconception speaks to its currency.

[195] Examples of the history of science popularization include: Bernadette Bensaude-Vincent, "A Historical Perspective on Science and Its 'Others'." *Isis* 100, no. 2 (2009): 359-68.; Bernard V. Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago, IL: University of Chicago Press, 2007).; Ralph O'Connor, "Reflections on Popular Science in Britain: Genres, Categories, and Historians," *Isis* 100, no. 2 (2009).; Katherine Pandora and Karen A. Rader, "Science in the Everyday World," *Isis* 99, no. 2 (2008): 350-64.

[196] Webb, *Buffalo Land,* 36, 38.; Davidson, "Edward Drinker Cope, Professor Paleozoic and 'Buffalo Land,'" 177.

sea."[197] Flexing his scientific imagination, the Professor explained the creature was of "an age of war…[when] [w]inged reptiles filled the air, in appearance more hideous than any creation of the imagination."[198] Later, another hunter directed the party to "a spot where he had seen portions of an immense skeleton."[199] However, only one Mastodon vertebra remained because "some Indians had passed Fort Dodge with the large bones lashed on their ponies, taking them to a medicine-lodge on the Arkansas, to be ground up into good medicine."[200] The Native American's interpretation of the fossils as those of the "big buffaloes which roamed over the plans during the times of their fathers" was prefaced with the fact that the bones were in fact those of a Mastodon. Western science was privileged by Webb as he sought to be a credible authority on the nature of the American West. However, his florid accounts of the deep past were no less infused with drama and teleology as those of the Indians. For example, regarding the formation of these fossils, the narrator stated, "[i]n those ages of roaring waters and hissing fires, she [Nature] had clothed the bones in stone, that they might withstand the gnawing tooth of time, and thus handed them down to the wondering eyes of the Nineteenth Century."[201]

No less teleological was his description of the watery paleo-environment that once clothed the western plains. While traveling through the West, the narrator conjured an image of the Western Cretaceous Interior Seaway (WCIS) of the Cretaceous Period:

> We were on the great earth-ocean; upon either side, until striking against the shores of the horizon, the billows of buffalo-grass rolled away. It seemed as if the Mighty Ruler

[197] Webb, *Buffalo Land*, 324-326.
[198] Webb, *Buffalo Land*, 326.
[199] Webb, *Buffalo Land*, 384.
[200] Webb, *Buffalo Land*, 384.
[201] Webb, *Buffalo Land*, 329.

> had looked upon these waters when the world was young, and said to them, 'Ye waves, teeming with life, be ye earth, and remain in form as now, until the planet which bears you dissolves!'…and whenever man's busy industry cleaves asunder the surface, the depths, like those of ocean, give back their monsters and rare shells.[202]

Facilitating further travel through the passage of deep time for his readers, Webb admitted "[w]e have no means of computing how long the cretaceous sea existed, but we know that it passed away and was replaced by large fresh-water lakes those of the plains being bounded on the west by the Rocky Mountains" [Figure 47].[203] The words, "remain in form now, until the planet which bears you dissolves" painted an image of permanence in the arid West that Webb concurrently described as a former seascape. This was no coincidence of language and narrative construction. In the eyes of western boosters, a resource-rich, stable, and habitable environment was an essential precondition for a prosperous settlement.[204] As a speculator and railroad agent, Webb was very interested in painting the plains as an idealized inland agricultural empire that would flourish into the future.

Webb's belief in the plains as a persistent place of pleasurable hominid habitation made him stubborn and unwilling to concede to scientific authority on the subject of human presence in the deep past.[205] While viewing supposed fossil footprints, Webb's

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[202] Webb, *Buffalo Land*, 112-113.
[203] Webb, *Buffalo Land*, 337-338.
[204] William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: W. W. Norton, 1991), 31-41.
[205] For histories of humanity's origins and position in time, see: Glyn Edmund Daniel and Colin Renfrew, *The Idea of Prehistory* (Edinburgh: Edinburgh University Press, 1988).; Brian M. Fagan, *The Great Journey: The Peopling of Ancient America* (Gainesville, FL: University Press of Florida, 2004).; Donald K. Grayson, *The Establishment of Human Antiquity* (New York: Academic Press, 1983).; Andrew Shryock, Daniel Lord Smail, and Timothy K. Earle, *Deep History: The Architecture of Past and Present* (Berkeley, CA: University of California Press, 2011).

Professor admitted that "[g]eology has held that man did not exist during the time of the great lakes," and Webb's narrator informed his readers that "[m]any scientific men, among whom is Professor Cope, affirm that they must be the work of Indians long ago, as the age of the rock puts it beyond the era of man."[206] However, Professor Paleozoic – or Webb himself – disagreed with these scientific authorities and explained, "[w]e have here the evidence of the rocks that man existed on this earth when the vast level upon which you are about to enter was covered by its mass of water. The waves lapped against the Rocky Mountains on the west."[207] Webb was sure to inform his reader of the vast changes that had been rendered on the land as it once was covered with magnolia, walnut, and butternut and now was "a desolate prairie."[208] This chronology offered by the Professor illustrated that contrary to what some geologists had alleged, the western environment had a long lineage of human habitability in alignment with biblical accounts.[209]

The professor's theory was depicted in an illustration titled "One of The First Families" that shows a family of human-like feline creatures dwelling in a furnished cave with dinosaurs visible out of the mouth of the residence [Figure 48].[210] Even if Webb's

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[206] For a discussion of the types of footprints found in rock, see: R.A. Gastaldo and W.F. Tanner, *The Evolution-Creation Controversy: Perspectives on Religion, Philosophy, Science, and Education: A Handbook: Proceedings of a Symposium Convened by Robert A. Gastaldo and William F. Tanner* (Paleontological Society, 1984).; Marsh placed "early man" in the Pliocene.; Othniel Charles Marsh, "Introduction and Succession of Vertebrate Life in America," an address delivered before the American Association for the Advancement of Science in Nashville, TN (New Haven, CT: Tuttle, Morehouse & Taylor Printers, 1877), 47, 52-54.; Webb, *Buffalo Land*, 107.; For an account of a set of supposed giant human footprints debunked by Marsh, see also: Ray Stannard Baker, "Stories of the Great American Scientist. Prof. Marsh.," *The San Francisco Call*, April 9, 1899.

[207] Webb, *Buffalo Land*, 108.

[208] Webb, *Buffalo Land*, 108.

[209] However, the Professor seems to contradict this theory with an brief description of Earth's history that occurs earlier in the narrative. Webb, *Buffalo Land*, 327.

[210] Webb, *Buffalo Land*, 347.

readers did not accept this theory of permanence, they might have accepted his proposed potential to return to the fertility and temperate environment that once existed. Soon after this revelation of humanity's deep past, the Professor described the paleo-plains as a watery region once covered with lakes that "abounded with fish" and with "vegetation at once so beautiful and so rich in growth that earth has now absolutely nothing with which to compare it."[211] Webb stated that it is "folly" to believe that a former landscape "so peculiarly fitted for man's enjoyment" should remain abandoned by the "human race" because of the present-day absence of those once "delightful characteristics."[212] The Western environment was made for "man" or can be remade "through man's busy industry."[213] Accordingly, echoing Hayden's paleo-restorative sentiment and the theory that "rain follows the plow" that will be discussed in the next chapter, Webb stated, "it may be said that all the acts of man in this vast region have tended to produce conditions on the earth's surface ameliorative of the climate."[214]

People have been using fossils to provide the bedrock for legends and myths for millennia.[215] Those who settled and promoted settlement in the American West were no different. From the vast array of marine fossils and the fossilized vegetation surrounding coal measures, they conjured an image of the West that belied the "Great American

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[211] Webb, *Buffalo Land*, 111.
[212] Webb, *Buffalo Land*, 111.
[213] Webb, *Buffalo Land*, 113.
[214] Webb, *Buffalo Land*, 484.; This claim is in accordance with the popular nineteenth-century "rain follows the plow" thesis that will be discussed in Chapter 7. The Kansas Pacific Railroad, for which Webb worked, was particularly interested in testing this thesis by creating experiment stations that tested the effects of planting trees and crops on climate. Charles Kutzleb, "Can Forests Bring Rain to the Plains?," *Forest History* 15, no. 3 (1971): 16.
[215] Adrienne Mayor, *The First Fossil Hunters: Paleontology in Greek and Roman Times* (Princeton, NJ: Princeton University Press, 2000).; Mayor, *Fossil Legends of the First Americans*.; Justin B. Delair and William A. S. Sarjeant, "The Earliest Discoveries of Dinosaurs," *Isis* 66, no. 1 (1975): 5-25.

Desert" and supported the myth of the West as an agricultural garden beckoning settlers to cultivate the land and restore it to its paleo-past. To some this was a biblical imperative. They must restore the fallen world described in scripture. These landscapes were antediluvian—before God's wrath wiped the Earth clean of the sin and violence that inhabited it—and could be restored to their lush former glory. The idea of a flooded Earth aligned well with the marine fossils found across the globe in terrestrial environments. The visions of antediluvian creatures that looked like ferocious monsters also accorded well with the violence that characterized the cause of God's wrath that wiped the Earth clean by flood. Absent the aid of radiometric dating to extend the age of the earth and an accepted evolutionary mechanism situated in deep time, the true depth of time required for these transformations could not be fully appreciated. Even James Hutton, credited with the discovery of geologic time, saw geologic history as unfolding in cycles.[216] Therefore, for some the bodies of water that once submerged the plains and abounded with life may, in fact, return. And absent concrete methods for determining the age of the earth, speculation could run wild. Nevertheless, as discussed in Chapter 2, there was wide recognition that the earth too had a history and scientists probed how that history expressed itself in its structure and composition. They accessed material nature and were able to envision the former seascape of the Cretaceous. Challenging James Ussher's short biblical chronology of the earth, the images and scientific descriptions that emerged from

[216] Mott T. Greene, *Geology in the Nineteenth Century: Changing Views of a Changing World* (Ithaca, NY: Cornell University Press, 1982), 47.

these treks through the ancient past began to aid in the public recognition of the expanses of geologic time.[217]

Geology in Webb's day made his conclusions a bit more probable than today's geology allows since his contemporaries did not have radiometric dating and were as yet unfamiliar with continental drift or tectonic theories needed to reconstruct paleo-climates and embrace deep time. Webb could not know that two major factors in the composition of the former environment he wished to reclaim were the North American continent's previous proximity to the equator and the atmosphere's extreme concentration of greenhouse gasses.[218] Using the scientific tools of his day, he remained confident that this ancient lush Eden could be restored to its former fertility, and that the agrarian and industrial West would flourish. With evident purpose, Webb began the section of his narrative devoted to overturning Stephen Harriman Long's "Great American Desert," and

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[217] Claude C. Albritton, *The Abyss of Time: Changing Conceptions of the Earth's Antiquity after the Sixteenth Century* (Mineola, NY: Dover Publications, 2002).; Stephen Baxter, *Ages in Chaos: James Hutton and the Discovery of Deep Time* (New York: Forge, 2003).; Peter J. Bowler, *Evolution: The History of an Idea* 25th Anniversary Edition (Berkeley, CA: The University of California Press, 2009), 29, 234.; Bowler, *Fossils and Progress.*; Paul D. Brinkman, *The Second Jurassic Dinosaur Rush: Museums and Paleontology in America at the Turn of the Twentieth Century* (Chicago, IL: University of Chicago Press, 2010).; Joe D. Burchfield, *Lord Kelvin and the Age of the Earth* (Chicago, IL: University of Chicago Press, 1990).; Michael J. Freeman, *Victorians and the Prehistoric: Tracks to a Lost World* (New Haven, CT: Yale University Press, 2004).; Robert West Howard, *The Dawnseekers: The First History of American Paleontology* (New York: Harcourt Brace Jovanovich, 1975), 255.; Martin J. S. Rudwick, *Bursting the Limits of Time: The Reconstruction of Geohistory in the Age of Revolution* (Chicago, IL: The University of Chicago Press, 2005).; Rudwick, *The Meaning of Fossils*, 70, 252-255, 264-265.; Martin J. S. Rudwick, *Worlds before Adam: The Reconstruction of Geohistory in the Age of Reform* (Chicago, IL: University of Chicago Press, 2008).; Ronald Rainger, "The Rise and Decline of a Science: Vertebrate Paleontology at Philadelphia's Academy of Natural Sciences, 1820-1900," *Proceedings of the American Philosophical Society* 136, No. 1 (Mar., 1992), 1-32.; David Sepkoski and Michael Ruse, *The Paleobiological Revolution: Essays on the Growth of Modern Paleontology* (Chicago, IL: University of Chicago Press, 2009).

[218] Since the sixteenth century, some had observed that the continents seemed to fit together. However, not until the late-twentieth century was there a mechanism established for the shifting continents. See: Naomi Oreskes ed., *Plate Tectonics: An Insider's History of the Modern Theory of the Earth* (Cambridge, MA: Westview Press, 2001).; Iowa Department of Natural Resources, "Global Climate Change and the Cretaceous World," accessed March 28, 2013. http://www.igsb.uiowa.edu/Mapping/greenhse/grnhouse.htm.

what would later become John Wesley Powell's arid American West with a richly poetic description of the former seascape.[219] He used this paleo-geologic vision to override the dominant perception of the American West as a parched land, marked by stark antagonism to organic life.[220] Instead, it was a once, and future, marvelously fertile land, rich with water and open to eager settlers.[221] Science supported elements of Webb's watery musings and consequently bolstered the cultural imperative of populating the American West. From its prevalence in USGS documents and booster literature, it is clear that material knowledge of the West as a former seascape was not trapped within scientific circles; rather it radiated from scientific reports to reach an interested popular audience. Oddly, a new understanding of the agricultural potential of the West emerged from the deep past of the plains. As a result, settlers, boosters, and the railroads could access and use paleo-environments in order to envision and (re)construct the past and future of the West.

The images that helped to support Webb's claims and encouraged his readers to envision the paleo-past of the plains to overturn their negative reputation were painted by another booster by the name of Henry Worrall.[222] Like Webb, Worrall sought to erase unfavorable images of the West from the minds of prospective settlers. One of his most famous attempts to destroy claims of Kansas' aridity after news spread of a dramatic

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[219] Webb, *Buffalo Land*, 114-120.
[220] For a historiographical treatment of the aridity thesis concerning the "Great American Desert," see: Martyn J. Bowden, "The Great American Desert in the American Mind: The Historiography of a Geographical Notion," in *Geographies of the Mind: Essays in Historical Geography*, ed. David Lowenthal and Martyn J. Bowden (New York: Oxford University Press, 1976), 119-147.
[221] Webb was not alone in this dream of an American agricultural paradise. For a historical treatment of this, see: Henry Nash Smith, *Virgin Land: The American West as Symbol and Myth* (New York: Vintage Books, 1950), 138-305.; Karen De Bres, "Imagining Kansas Place, Promotion and Western Stereotypes in the Art of Henry Worrall," *Great Plains Quarterly* 27 (Summer 2007): 177-192.
[222] Davidson, "Edward Drinker Cope, Professor Paleozoic and 'Buffalo Land,'" 185-186.

drought in 1860 was titled "Drouthy Kansas." The picture began as a charcoal sketch in 1869 and depicted a drowned, fecund and lush landscape where men were dwarfed by grapes, potatoes, corn, and a monstrous watermelon. That year it was published on the cover of *Kansas Farmer* magazine. In the years that followed it became part of a land advertisement in 1875, soon after it graced the pages of the book *Resources of Kansas* in 1877, and finally became a color painting in 1878.[223] The image served to lure many settlers to Kansas, but when drought and grasshoppers returned in the mid-1870s, those he baited with "the diabolical seductiveness of that picture" were furious and called for his head.[224] The painting depicted a Kansas that was oddly similar to the verdant, and monstrous, flora and fauna of the Cretaceous Kansas described by Cope and Webb [Figure 49]. It brought hope to those who wished to start a life in the area that they grew up viewing as the Great American Desert.[225]

Webb was not alone in artfully juxtaposing the watery deep past with the desert image of the West. As if the label the "Great American Desert" was not bad enough, the Bad Lands were an area especially in need of the deep past to revive its poor reputation and regrettable name. In the minds of the Northern Pacific Railroad boosters the unfortunately named Bad Lands were in need of a paleo-environmental facelift. Fortunately fossil hunters had spent a considerable amount of time and effort in uncovering the wonders of this region. The 1882 Rand, McNally & Co. *Northern Pacific*

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[223] Susan McCarthy, "Tired of Dorothy and Toto? Three Nineteenth-Century Icons of Kansas," *Kansas History: A Journal of the Central Plains* 36 (Spring 2013): 26.
[224] Rebecca Martin, "Cool Things - Drouthy Kansas Painting - Kansas Historical Society," accessed June 21, 2014. http://www.kshs.org/kansapedia/cool-things-drouthy-kansas-painting/10123.
[225] For more information on advertising Kansas, see: Karen De Bres, "Come to the 'Champagne Air': Changing Promotional Images of the Kansas Climate, 1854-1900," *Great Plains Quarterly*23 (2003): 111-126.

guidebook called upon a professor explain the science of the "most curious and interesting wonders, along the entire line of the Northern Pacific, or, indeed, on the American Continent" that will "always remain of paramount interest to the student of nature."[226] The professor described the region as follows:

> mounds beyond mounds, like ocean waves lost in distance; but interspersed with all these are beautiful slopes many acres in extent, green as emerald, and lovely spots covered with fragrant ground juniper, fit carpet for a queen.

The area was ocean-like and covered in verdure. It was like a paradise. Not only was it beautiful, it was useful. It had coal, curiosities, and fertile soils.

> [In the] Bad Lands are frequent beds of coal, some of which are thick enough to work, and must become of great value…On the lignite beds are stumps and parts of trunks of large trees transformed apparently, into solid quartz. There are thousands of these – it is difficult to travel without meeting them…Though much of the water of the Bad Lands contains sulphate and soda, there are yet many springs of pure water. There is also not a little good land. The pasturage is excellent in many places, and many beautiful farms may be made in the Bad Lands country. The grasses are rich, and higher than seen elsewhere.

The geologic history of the region was to thank for these conditions that were so amenable to settlement. For example, this region's watery past was responsible for the available coal resources.

> A lake once existed where the Bad Lands now are. Into this, the rivers carried sediment till it became a swamp, and trees flourished till the mass of vegetable matter was made

[226] Member of the Chicago Press, *The Northern Pacific Railroad. Sketch of Its History: Delineations of the Divisions of Its Transcontinental Line: Its Features as a Great through Route from the Great Lakes to the Pacific Ocean: Its Relations to the Chief Water Ways of the Continent, and a Description of the Soils and Climates of the Regions Traversed by It as to Their Adaptability to Agricultural Production with Descriptive and Statistical Exhibits of the Counties on and near Its Line in Minnesota and Dakota. For the Information of Those Seeking New Homes and Profitable Investments* (Chicago, IL: Rand, McNally and Company, Printers, 1882), 30.

> sufficient to form a coal bed. As the mountains to the west rose and the land here sunk. Another lake was formed. Sediment became deposited in it, covering the previous deposit of vegetable matter, the lignite was formed. Land and water changed placed more than twenty times during the deposit of the tertiary beds. The coal is not equal to the carboniferous formation, but these lignite beds will be found to underlie a large portion of Dakota.[227]

For those who were looking to farm or settle in the Bad Lands by taking advantage of its coal and fertile lands, or who were simply interested in its natural curiosities, the Northern Pacific could take them there on its expanding rail network. The juxtaposition of ocean metaphors and descriptions of desert land with its watery paleo-past made for a very malleable environmental vision for the reader of this literature. In a sense there was no consistent description that could encapsulate the varied nature of the Bad Lands. What the reader likely came away with was that the area was plastic and capable of supporting settlement.

Similarly, in order to assure the reader of the 1891 *Official Northern Pacific Railroad Guide*, that the Bad Lands were indeed a misnomer, the authors explained its geological history.

> The term Bad Lands, as applied to this region, is a gross misnomer. It conveys the idea that the tract is worthless for agricultural and stock-raising purposes. Nothing could be wider of the truth. The fact is, the soil possesses fertilizing properties in excess, and the luxuriant grasses which here flourish, attract herbivorous game animals in large numbers…This entire region, geologists tell us, was once the bed of a great lake, on the bottom of which were deposited, for ages, the rich clays and loams which the rains carried down into its waters. This deposit of soil was arrested from time to time sufficiently long to allow the growth of luxuriant vegetation, which subsequently

[227] *The Northern Pacific Railroad,* 30-31.

> decayed, and was consolidated by the pressure of succeeding deposits, transforming itself into those vast beds of lignite coal which abundantly meet the need of the country for fuel.[228]

Once again, the geological history of the Bad Lands was the source of its redemption. Due to the nature of the deep past of the region, the land was fertile and lavish stores of lignite were to be found for the use of settlers. For those tourists just passing by, there were countless curious ancient relics such as "fossil remains are oysters, clams and crustaceans" to be scooped up as souvenirs of a western sojourn. The deep past, as revealed by scientists and amateur collectors, enabled the railroads to take advantage of public interest in natural history curios and make mention of fossilized curiosity collection to encourage traffic on their lines. Furthermore, the agriculturally advantageous and industrially useful treasures produced in the Bad Lands through geologic time offered the railroads an opportunity to advertise for natural advantages of the land along their lines.

Geologists, paleontologists, and the railroads were now interacting and cooperating in this manner in part because of the resources available generated through geologic time. Yet, it was not just railroad laborers, engineers, and station agents that contributed to the practice of American paleontology and geology. In 1909, the Union Pacific Railroad also published literature on paleontology titled *The Fossil Fields of Wyoming* based on a scientific excursion that the passenger department sponsored in July 1899 to what one collector called "this new Eldorado."[229] Railroad publications were also

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[228] W. C. Riley, *The Official Northern Pacific Railroad Guide, for the Use of Tourists and Travelers over the Lines of the Northern Pacific Railroad* (St. Paul, MN: W.C. Riley, 1891), 171-173.
[229] Elmer S. Riggs, "Fossil-Hunting in Wyoming," *Science* 11, no. 267 (1900): 233.

a common avenue through which the paleontology of the West reached a popular audience. The Union Pacific Railroad (UPRR), for instance, was interested in promoting fossil knowledge to a lay audience as a method of promotion for their lines.[230] The *Wall Street Journal* commented that the trip,

> indicates a liberal policy where the interests of its communities are involved. The advantages of this unique scheme are many, not the least being that of advertising. If Wyoming has mineral resources, Union Pacific evidently thinks it has, the scientists will soon discover them and a rush must inevitably follow. In any case the attention of settlers and investors will be attracted to a section of the country that has wide opoprtunties [sic] and which needs to be more densely populated.[231]

This news outlet saw the value beyond the opportunities for science. The Union Pacific Railroad could use these scientists to perform reconnaissance for them and encourage further prospecting, investment and settlement along their lines in the sparsely populated state of Wyoming.

In order to entice educators and scientists to venture into the Wild West on a fossil hunt with the Union Pacific, they sent out invitations that include a pamphlet titled *Some of Wyoming's Vertebrate Fossils* which was later handed out to passengers as well. In it, Wyoming was described as "the geological wonderland of the world" with "the most extensive and fertile fossil fields known."[232] One particularly recent fossil find by William Harlow Reed was so large that it was even grander than Marsh's Brontosaur that "[b]eside this monster the largest Dinosaurs of Europe, and, indeed, the world, have

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[230] Tom Rea, *Bone Wars: The Excavation and Celebrity of Andrew Carnegie's Dinosaur* (Pittsburgh, PA: The University of Pittsburgh Press, 2001), 103-106.
[231] "Union Pacific Progresses," *Wall Street Journal*, April 4, 1899.
[232] Union Pacific Railroad, "Some of Wyoming's Vertebrate Fossils," 3.

remained since its discovery as only pygmies."[233] This creature came from a time "in the history of Wyoming, geologists say that the State had numerous fresh-water lakes and a climate that was semi-tropical."[234] The bones that remained from the inhabitants of this watery landscape, according to the pamphlet, were available for the taking and could assist in creating huge museums. Even more, "work in procuring these rare specimens is as exciting as gold hunting, and many times one finds bones that are worth more than their weight in gold."[235] These valuable natural resources were there as material signs of times long past for all to see and profit from [Figure 50].

While there was abundant press that covered the expedition as it was happening, a decade after the expedition, *The Fossil Fields of Wyoming* pamphlet was published to further advertise the scientific achievements of the expedition.[236] In July, 1899," the pamphlet read, "the passenger department of the Union Pacific Railroad sought to revive interest in the further exploration of this wonderful field, and to that end invited a number of scientific men to visit that part of Wyoming and make personal investigation of the field."[237] The resulting publication stressed the massive amount of fossil specimens in Wyoming, their relative ease of access, and the value of science in dispelling myth.

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[233] Union Pacific Railroad, "Some of Wyoming's Vertebrate Fossils," 5.
[234] Union Pacific Railroad, "Some of Wyoming's Vertebrate Fossils," 11.
[235] Union Pacific Railroad, "Some of Wyoming's Vertebrate Fossils," 17.
[236] A sampling of the news coverage includes: "The Fossil Wonderland of the World," *San Francisco Chronicle*, January 23, 1899.; "To Study Wonderful Fossils," *New York Times*, June 8, 1899.; "Fossil Hunting in the Rockies," *The Independent*, October 5, 1899.; "In the Interest of Science. Unique Invitation to Colleges from Union Pacific Railroad," *The Washington Post*, April 1, 1899.; "To Hunt for Dinosaurs," *The Anaconda Standard*, June 17, 1899.; "Rich Finds Made by Fossil Hunters," *The Washington Post*, August 5, 1899.; "Grave Robbing Expedition," *The Omaha World Herald*, June 8, 1899.
[237] Union Pacific Railroad Passenger Department, *The Fossil Fields of Wyoming* (Omaha, NE: Passenger Department, Union Pacific Railroad Company, 1909), 3.

The pamphlet began with the "Story of the Discoveries" by William Harlow Reed, then Curator of the Museum at the University of Wyoming. Here Reed recounted a short history of the fossil finds in Wyoming and was sure to note his 1877 discovery at Como Station. "There is no square on earth," claimed Reed, "as rich as Wyoming in its fossil forms of ancient life." But no simple settler could collect these curiosities correctly. "[I]t takes, first, knowledge and, second, energy to find and bring these things to light; but that is all that is necessary to equip the fossil hunter for successful work in Wyoming."[238] Reed had these skills and assisted in assuring the success of his institution when the "Wyoming University commenced in 1895 to collect material for a museum," and by the time of the publication of *Fossil Fields of Wyoming* they had secured "about eighty tons of fossil bones."[239] The expedition to find a *Triceratops* in Wyoming, of which J. P. Sams detailed his experience as a fossil hunter, recorded the beginning of Reed's work to secure material that would be under his supervision as curator. In June of 1895, Sams stated:

> While we are eating our dinner we see two strangers coming up the canon in a wagon. They prove to be Professor Knight and his guide, William Reed. I have seen them both before but as I go out to welcome them to camp I see they are both my Brothers [Masons] and we are friends at once. They belong to the University of Wyoming located at Laramie City. They have travelled one hundred and fifty miles to meet us. They bring us a splendid mess of mountain trout that they have caught on the way down through the Laramie Mountains.[240]

[238] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 7.
[239] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 6-7.
[240] Brown and Sams, *A Triceratops Hunt in Pioneer Wyoming*, 73-74.

Amongst the chaos of competition in fossil hunting the western frontier, it seems that cooperation did exist, in this case between individuals at the University of Kansas and the University of Wyoming. *The Fossil Fields of Wyoming* was another example of cooperation in the name of science, what Vetter called "[t]he pinnacle of all science along the railroad."[241]

Before the Union Pacific Railroad published *The Fossil Fields of Wyoming* in 1909, Wilbur C. Knight wrote his own account for *National Geographic Magazine* in 1900. Knight was the scientific head of the expedition. His account reads much like an adventure narrative and he ultimately concluded that the scientific discoveries themselves were not the only value derived from the expedition, but,

> [t]he field experience has deepened the interest and broadened the horizon of every member of the expedition. Young and old were alike enthusiastic over the opportunities offered by this region for field-work in geology. While they returned to their various spheres of duty enriched with material for use in their future class-work, they all carried home with them that lasting benefit and stimulus which are derived from contact with the keen minds of those working along similar lines of research under more or less varying conditions.[242]

The approximately one hundred expedition members were enriched and enlivened by the experience afforded to them by the Union Pacific Railroad which "[i]n many cases…made attendance possible where otherwise the expense of a long railroad journey

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[241] Jeremy Vetter, "Science Along the Railroad: Expanding Field Work in the Us Central West.," *Annals of Science* 61, no. 2 (2004/04/01 2004): 197.
[242] Wilbur C. Knight, "The Wyoming Fossil Fields Expedition of July, 1899," *The National Geographic Magazine* (December 1900): 462, 465.

would have been a difficulty that could not have been overcome."[243] Given the value and seeming necessity of fieldwork for paleontologists and geologists it is of interest that "many members of the party had their first experience of camp life" on this excursion.[244] Educators from "[t]hirty two institutions of learning and research from Minnesota to Texas," according to curator of the U. S. National Museum Charles Schuchert, attended this adventure and they inevitably brought their experience home with them and used it to teach their students.[245] The nature of science at the turn of the century left scientists with the option of travelling long-distances for fieldwork. Previously, most scientists had to take advantage of the growing rail network to perform their research in the field. The suggestion from Knight's statement is that it was now optional to go to the West for fieldwork. There are a number of factors that allowed for this. First, the abundant fossil finds located in latter half of the nineteenth century were now housed and many times backlogged at institutions of learning for scientists to examine. Second, work in the laboratory was taking increasing prominence in scientific practice. And finally, competition was rife for fossil sites already scooped up by settlers and the most powerful and prominent institutions of science. Even with the ever-expanding rail network, it started to become more difficult and perhaps more importantly less necessary to venture into the field to study science. As a man who frequently visited the field, Knight likely regretted this situation and relished the fact that these greenhorn scientists had participated in a vital element of scientific practice.

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[243] Knight, "The Wyoming Fossil Fields Expedition of July, 1899," 449, 453, 465.; Union Pacific Railroad, *The Fossil Fields of Wyoming*, 22.
[244] Knight, "The Wyoming Fossil Fields Expedition of July, 1899," 450.
[245] Charles Schuchert, "The Fossil Field's Expedition to Wyoming," *Science* 10, no. 255 (1899): 725.

In *The Fossil Fields of Wyoming* pamphlet published by the Union Pacific Railroad, one scholar's field experience was illustrated in his vision of the present and past of the land, as he attributed the party's abundant fossil finds to the watery paleo-environments that once characterized the now arid state of Wyoming. Professor J. A. Yates of Ottawa University stated, "[t]he hundreds of square miles of these beds containing thousands of tons of bones of these huge vertebrates, some of which are exposed by erosion each year, impresses one with the vastness of the burying ground over which we were traveling and the history of its formation and inhabitants while it was a low marshy plain."[246] At the conclusion of his remarks, Yates was sure to thank "our leader Prof. Wilbur C. Knight, for his able and efficient service and his many valuable suggestions, also to the Union Pacific Railroad Company for its many courtesies."[247] Curiously absent from the thanks bestowed upon Knight and the railroad, were the "twenty or more…drivers who were well acquainted with the territory over which we were to travel."[248] Their local knowledge was apparently not as vital as the scientific knowledge of Knight and the long-distance travel provided by the railroad.

They did recognize, however, how vital the barren and dry western lands were to their enterprise. Professor J. E. Todd of the University of South Dakota listed a number of the expedition's virtues. One crucial element was the nature of the West. The arid character of the western environment, "the absence of vegetation and clearness of atmosphere in Wyoming," conspired to allow the scientists to see more clearly the "folds,

[246] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 9.
[247] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 11.
[248] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 22.

faults, wind work, and stream work, stratification and concretions."[249] Another geologist remarked that Wyoming was an "open book on geology."[250] Yet another stated, "[t]here is little vegetation to obscure the details of the topography; the semi-arid climate lends at once to develop and preserve these details, so that all of them stand out in clearest definition."[251] Revealed to the scientists were,

> the oldest fresh water lakes, with their huge dinosaurs; the stretches of the Cretaceous with its sandstone ridges and mesas, its gumbo plains and slopes, its chalk cliffs glaring across the waste, its swarms of fossil shells, its gigantic globular concretions, its coal beds with fossil palms and deciduous trees; the Tertiary lake beds, with their monstrous mammalian bones, remains of Nature's efforts in preparing the various beasts of the present time; the gravel-spread and boulder-dotted terraces of the Pleistocene age, records of the former floods which worked so faithfully to humble the pride of the rising Rockies, and convey their grandeur to beautify and enrich the plains of the Mississippi – all these are now vivid realities in the minds of all who rode over them and worked about them with this expedition.[252]

Todd was traveling through time to see these actions take place. The railroad and the physical nature of the West (its aridity) enabled he and his companions to envision the deep past of the West.

Todd believed that the expedition aided in the advancement of science as well as "promot[ed] popular interest in science and education" through the popular press and the dispersal of the many fossil finds to institutions across the country.[253] For the lay public,

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[249] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 13.
[250] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 18.
[251] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 49.
[252] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 15.
[253] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 15.

> [i]t reveals to many a new world of the imagination. Science has swept into oblivion the whole brood of mythological monsters, centaurs, griffons, chimeras and dragons, that once delighted the lovers of the terrible and strange, but now it is substituting the monsters of geologic lore. It arouses new interest in "The fairy tales of Science and the long result of Time."
>
> It will stimulate a more healthy interest in science for its own sake.[254]

Todd's hope was that science would triumph over the ignorance of mythology and folklore. Yet, he admitted that geology is in itself a type of "lore" with its own monsters, thereby placing it on a plane similar to the mythology it has "swept into oblivion." One scientist also stated that the interest to the general public is that the fossils found will "be used later for the convincing of the incredulous."[255] Popular interest and exposure was vital to the enterprise in Todd's eyes. To that end he finished his explanation of the expedition's benefits with stating:

> Let us hope that this expedition may arouse such lasting interest in scientists and the patrons of public museums in the wonders of the West that it may be but the first of a long series of similar vacation excursions which may prove of mutual advantage to all emerging in them and to the public at large.[256]

Todd valued public interest because it meant more funds and a more secure professional position as a scientist and professor. The role of the railroad in this equation was financial as well. The railroad supplied these scientists with a cheap opportunity to advance their careers. The railroad benefitted from this symbiotic relationship through the media exposure resulting from the research excursion and the geological knowledge generated

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[254] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 17.
[255] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 19.
[256] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 17.

by its participants. As an expedition member noted, "the Union Pacific Railroad is to be congratulated upon having contributed to the progress of civilization" in the advancement of science.[257]

There was also a fair amount of boosting for the agricultural potential of the region covered by the expedition. In a description of the "Geology of the Laramie Plains," a member of the expedition commented, "[t]he valleys along the streams are wide and often slope up gently to the terraces above. Grass abounds on the valleys, and, with judicious irrigation, can furnish plenty of hay and also good grazing."[258] The coal was also of good quality. "Some of this coal," claimed one expedition member, "I saw last summer in coal bins at Medicine Bow station and it certainly is a beautiful and pure looking coal."[259] The Union Pacific expedition also mined these coalmines for scientific specimens. In Carbon County, Wyoming, "[t]he entire party halted and we were soon busy collecting leaf impressions which overlay the coal to a thickness of at least four feet; the impressions are so perfect that the most minute markings of the leaves are as clear as the dried leaves of the various trees would show."[260]

While this expedition was fully funded by the Union Pacific, occasionally the railroad would also offer other scientists free travel or half fares.[261] At the same time enriching and advancing scientific knowledge and advertising the enlightened nature of the railroad, geological and paleontological interest increased passenger traffic and

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[257] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 21.
[258] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 27.
[259] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 47.
[260] Union Pacific Railroad, *The Fossil Fields of Wyoming*, 22.
[261] Thomson, *The Legacy of the Mastodon*, 173, 182, 242.

encouraged investigation into resources and routes needed for railroad construction.[262] Geological and paleontological interest increased passenger traffic and encouraged investigation into the resources and routes needed for railroad construction. The paleo-environment of the West enabled the railroads to advertise their enlightened nature, advance scientific knowledge, and fuel western expansion.[263]

Conclusion

The ancient character of western North America was put to use during the mid-to-late nineteenth century in order to see the fluid nature of the landscape. Literature composed concerning the past and future of the frontier drew heavily from geology to support their statements. News about old bones discovered in the West spread far through the telegraphs and on the iron rails that were linking remote regions to the nation's metropolises. The late nineteenth century was a boom period of fossil fascination and extraction that had commercial implications.[264] Dinosaurs and geohistorical landscapes were products and symbols of modernizing America.[265] In the world of coal-energy, they represented progress, dominance, destruction and cyclical resurrection. The railroads brought the scientists and the public face-to-face with the Earth's history by constructing their lines and by transporting passengers across the nation. As science gained a prominent position in American society, the railroads drew upon its power to boost for

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[262] Rea, *Bone Wars*, 103-117.
[263] Rea, *Bone Wars*, 103-117.; Jeremy Vetter, "Science Along the Railroad: Expanding Field Work in the Us Central West," *Annals of Science* 61, no. 2 (2004): 187-211.
[264] Or as W. J. T. Mitchell referred to them, "periodic outbursts of dinomania.": Mitchell, *The Last Dinosaur Book*, 10.
[265] W. J. T. Mitchell called dinosaurs the "totem animal of modernity." I believe that geohistorical landscapes are similarly important and cannot be disassociated from the creatures that roamed them in the past.: Mitchell, *The Last Dinosaur Book*, 67, 77-85.

their lines. They used the geologic history of the lands through which their locomotives sailed to speak of future settlement. The next chapter will expand on this use of geology further and discuss how it was implicated in the rise of the garden-West and the destruction of the Great American Desert.

A vernacular science of the West was being continuously redeployed and reformed in the minds of Americans.[266] Western geologic history could explain anything from the region's arid character to its Edenic past and future. In the context of America's rapid industrialization and thrust westward after the Civil War, the geology of the region was put to use in order to justify these imperatives and to see the nation's future as derived providentially from its past. The social psychologist Wolfgang Wagner recently put it like this: "Public discourse makes science more than and, at the same time, less than a stripped down version of the original." In fact, "the route scientific information takes from the laboratories to the public does not resemble an error-prone conduit but more a meat grinder mincing the chunks of scientific 'meat' and seasoning it with various cultural and imaginary spices."[267] Furthermore, as we shall see in the coming chapters, scientists and the public alike suffered from confirmation bias in assessing knowledge of the natural world. The history of the earth is as material as it is cultural.

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[266] In her study of antebellum America and geology, Conevery Bolton Valenčius refers to the science performed or thought about by the public as "vernacular science." This was science that was holistically integrated with the worldviews of Americans.; Conevery Bolton Valenčius, The Lost History of the New Madrid Earthquakes (Chicago, IL: University of Chicago Press, 2013), 9-11, 177, 184, 194, 213-15, 329-333.

[267] Wolfgang Wagner, "Vernacular science knowledge: its role in everyday life communication," *Public Understanding of Science* 16 (2007):19.

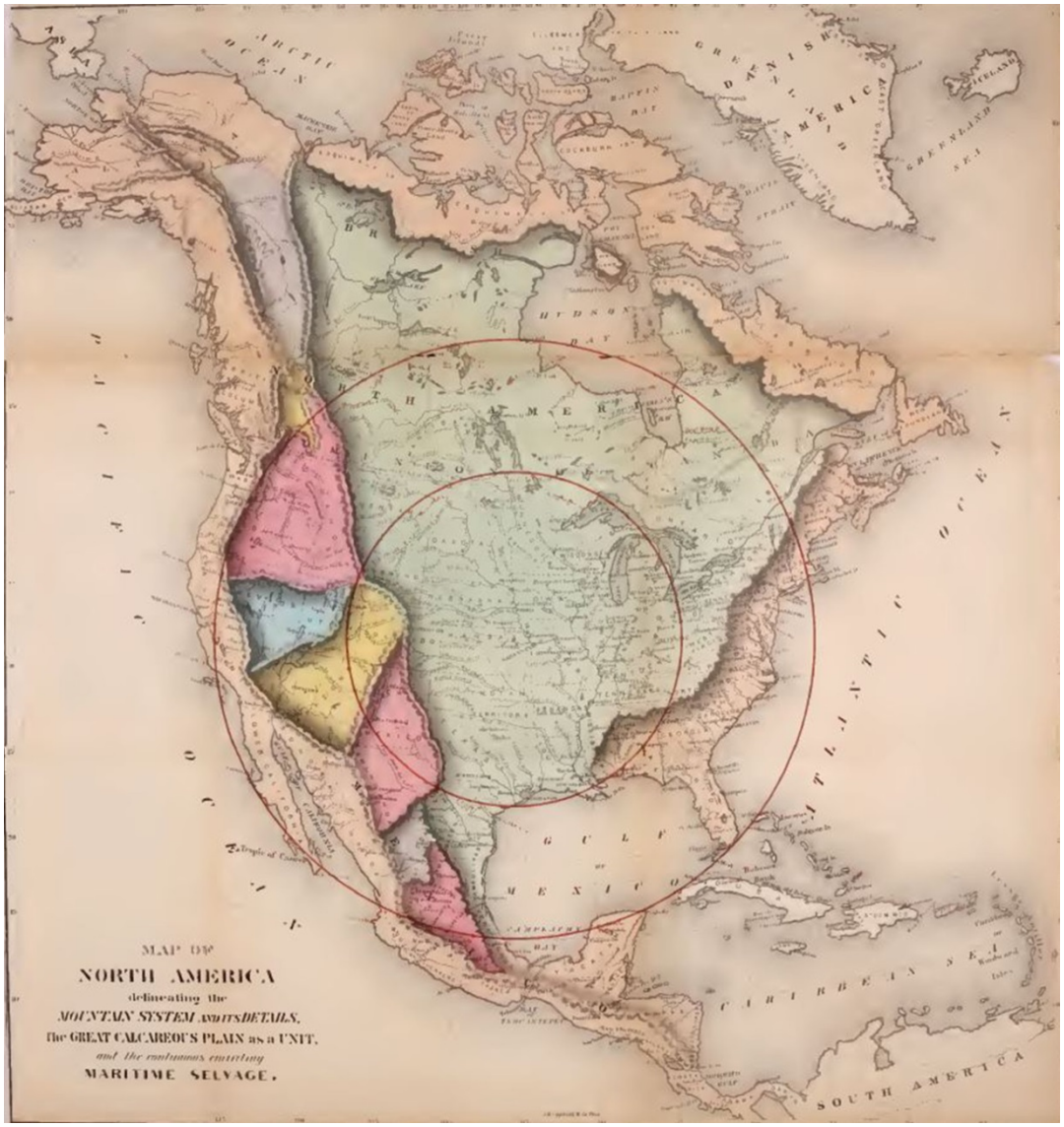


Figure 43. Great Calcareous Plain (1873). Source: William Gilpin, *Mission of the North American People Geographical, Social and Political: Delineating the Physical Architecture and Thermal Laws of All the Continents* (Philadelphia, PA: J. B. Lippincott & Co., 1873), 34-35.

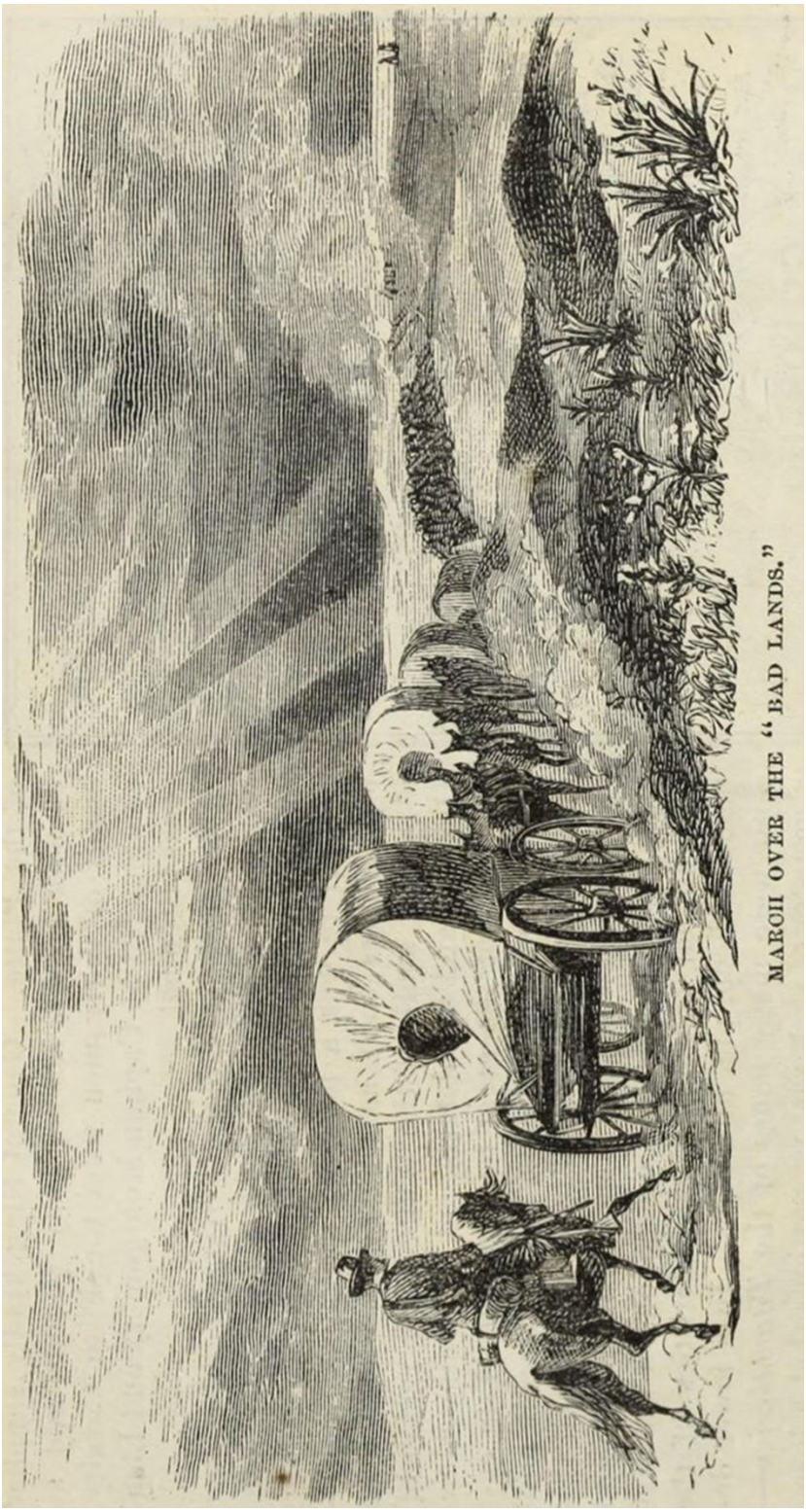


Figure 44. Yale Expedition (1870). Source: Charles Wyllys Betts, "The Yale College Expedition of 1870," *Harper's New Monthly Magazine*, October 1871, 665.



Figure 45. Antediluvian Remains. Source: “Remains of Gigantic Antediluvians,” *Scientific American*, June 15 1878.



Figure 46. “Diplomystus dentatus with Knightia in its mouth.” Source: “Green River Formation Fossils,” National Park Service, accessed March 24, 2015. http://www.nps.gov/media/photo/gallery.htm?id=F17B1C64-155D-451F-6765341D9B8E553F.



Figure 47. “The Sea Which Once Covered the Plains.” Source: William E. Webb, *Buffalo Land: An Authentic Account of the Discoveries, Adventures, and Mishaps of a Scientific and Sporting Party in the Wild West* (Chicago, IL: E. Hannaford & Company, 1872), 357.



Figure 48. “Developing – One of the First Families.” Source: William E. Webb, *Buffalo Land: An Authentic Account of the Discoveries, Adventures, and Mishaps of a Scientific and Sporting Party in the Wild West* (Chicago, IL: E. Hannaford & Company, 1872), 349.



Figure 49. “Drouthy Kansas” (1878). Source: “Drouthy Kansas,” Kansas Memory, Kansas Historical Society and the Kansas Historical Foundation, 1984.214.1, accessed January 12, 2014. http://www.kansasmemory.org/item/208096.



"BONE ROOM," UNIVERSITY OF WYOMING.

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Figure 50. “Bone Room.” Source: Union Pacific Railroad Passenger Department, “Some of Wyoming's Vertebrate Fossils,” (1899), 33.

THE REVIVAL OF THE GARDEN WEST AND ITS OPPONENTS: NORTH AMERICA'S GEOLOGIC HISTORY SUPPORTS A PROGRESSIVELY CHANGING WEST

> Twenty years ago Horace Greeley said that that portion of the West known then as the Great American Desert was only fit to grow sage brush and cactus. To-day no finer crops are grown anywhere in the United States than are grown in the Great Desert.[1]
> *The Western Garden: An Illustrated Floral Monthly*, 1893.

Perhaps no individual better represents the transition from a desert-West to the garden-West than the infamous newspaperman Horace Greeley.[2] His writings straddle the Civil War and represent the change wrought in the public imagination regarding the West's place in America's future. On a trip across the country in 1859, Greeley had come face-to-face with the Great American Desert, and yet after the Civil War he was widely credited in the popular press with the phrase "Go West, young man!" encouraging western settlement. Greeley's 1860 travel narrative *An Overland Journey from New York to San Francisco in the Summer of 1859* contained a chapter titled "The American Desert" in which he described the arid section of the country that he encountered along the south fork of the Republican River from northeastern Kansas to southwestern Nebraska into eastern Colorado.[3] In this chapter, Greeley dramatically detailed his

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[1] "Twenty Years Ago and to-Day," *The Western Garden: An Illustrated Floral Monthly*, Vol. 1 (February, 1893): 9.

[2] For further information about Greeley, see: Coy F. Cross, *Go West, Young Man!: Horace Greeley's Vision for America* (Albuquerque, NM: University of New Mexico Press, 1995).; Earle D. Ross, "Horace Greeley and the Beginnings of the New Agriculture," *Agricultural History* 7, no. 1 (1933): 3-17. ; Adam-Max Tuchinsky, *Horace Greeley's New-York Tribune: Civil War-Era Socialism and the Crisis of Free Labor* (Ithaca, NY: Cornell University Press, 2009).; Glyndon G. Van Deusen, *Horace Greeley, Nineteenth-Century Crusader* (New York: Hill and Wang, 1964).; Robert Chadwell Williams, *Horace Greeley: Champion of American Freedom* (New York: New York University Press, 2006).

[3] The geography of Greeley's journey is derived from his references of station numbers along the Pike's Peak Express and the following article that details that particular route: George A. Root and Russell K. Hickman, "Pike's Peak Express Companies: Part II - Solomon and Republican Route - Concluded," *Kansas*

"passage through the American desert."[4] Greeley's eyes saw the region as "the acme of barrenness and desolation."[5] It was windy and treeless, with "steadily degenerating" soils and sands that seemed "to be as pure as Sahara can boast."[6] "The dearth of water is fearful," reported Greeley, in this "region of sterility and thirst."[7] There were no animals in the surrounding area because "they pass rapidly through it, as I should urgently advise them to do."[8] It was a "treeless desert" where he had "not seen wood enough to make a decent pig-pen."[9]

On its way through the Great American Desert, Greeley's train was directed towards the burgeoning western city of Denver, Colorado. Writing from Denver, he continued to label the West as "the great American desert" where the climate was "terrible."[10] Even worse, Greeley believed the desert was "steadily enlarging its borders and at the same time intensifying its barrenness."[11] However, as he reached the Rocky Mountains, and the city of Denver, his descriptions became ever-so-slightly more sanguine and optimistic. What would become Colorado Territory in 1861 was known for its precious metals and, sustained on the wealth of the earth; the city of Denver had grown at the edge of the desert.

Historical Quarterly 13, no. 4 (1944): 211-242.; His travels were published in newspapers across the country. For example, see: Horace Greeley, "An Overland Journey," The Jeffersonian, September 29, 1859.
[4] Horace Greeley and Charles T. Duncan, *An Overland Journey from New York to San Francisco in the Summer of 1859* (New York: Knopf, 1963), 86.
[5] Greeley and Duncan, *An Overland Journey*, 81.
[6] Greeley and Duncan, *An Overland Journey*, 81.
[7] Greeley and Duncan, *An Overland Journey*, 81-82.
[8] Greeley and Duncan, *An Overland Journey*, 82.
[9] Greeley and Duncan, *An Overland Journey*, 82-85.
[10] Greeley and Duncan, *An Overland Journey*, 91, 95.
[11] Greeley and Duncan, *An Overland Journey*, 111.

After the Civil War, like many of his fellow Americans, Greeley embraced another vision of the West. The encouraging exclamation "Go West, young man!" was attributed to Greeley and became a mantra of the western migrant.[12] Numerous news articles concerning migration into the West during the late nineteenth century attribute "Go West, young man!" to Greeley.[13] The phrase was often used to boost for the West and paired with spectacular descriptions of western lands. In 1883, a Kanas newspaper carried such an article titled "The Garden of America." The state of Kansas was labeled the "garden of America, of the world" with "great beauty" and ideal temperatures which made the author "a convert to the late Horace Greeley's creed, 'Go West.'"[14] "Go West, young man!" reflected the hopes and dreams of western migrants who, after the Civil War, would ride West on railroads to make a new life and prosper in the garden of the world.

Even though Greeley's famous phrase was used to encourage western migration, the specter of his earlier comments lived on. For some Denverites, the harsh descriptions of Horace Greeley haunted their home for decades. In 1893, *The Western Garden: An Illustrated Floral Monthly* carried an editorial that sought to call Greeley out on his mistaken moniker. The quote that began this chapter comes from this source. In the eyes of the author of this piece, all that it took to transform this region was "muscle, money, and brain to overcome the obstacles that were in the way of success."[15] Were westerners

[12] For an examination of the difficulty in actually attributing the phrase to Greeley, see: Thomas Fuller, ""Go West, Young Man!"—an Elusive Slogan," *Indiana Magazine of History* 100, no. 3 (2004).
[13] For example, see: "For Sale," *The Forest Republican*, December 4, 1878.; *The New North-West*, March 31, 1882.; "Ho, for the West!," *The Carbon Advocate*, August 19, 1882.
[14] " "The Garden of America."," *The Dodge City Times*, September 6, 1883.
[15] "Twenty Years Ago and to-Day," 9.

defying nature with their efforts? Or, would nature conspire with humanity to make these changes manifest? This chapter will explore the scientific basis for beliefs that turned a desert into a garden. For many, the answer lay in the earth.

The geologic history of the American West was central to how its changing climate was authoritatively articulated. The shift from seeing the West as a desert to seeing it again as a garden after the Civil War was heavily influenced by Americans' increasing knowledge of the geological history of the North American continent. Among scientists, settlers and those boosting the West there was no universally accepted timescale for geologic change. What was clear from paleontological and geological remains, however, was that the West had dramatically changed from a watery and tropical region to a dusty and desiccated domain.[16] Perceiving time was crucial to recognizing these changes and their potential for occurring again in the West. For those who interpreted geoscience through scripture and saw the world as 6,000 years old, the idea that climactic shifts could occur in relatively short spans of time would not have been farfetched.[17]

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[16] James Fleming noted, "The public's demand for practical information for the settlement of the West and the emerging ecological interests of the naturalists resulted in new theoretical and practical links between meteorology and natural history." I contend that this was especially true in encouraging a productive exchange between geology and paleontology and meteorological science.; James Rodger Fleming, *Meteorology in America, 1800-1870* (Baltimore, MD: Johns Hopkins University Press, 1999), 135-136.

[17] Charles R. Kutzleb, "Rain Follows the Plow: The History of an Idea" (PhD diss., University of Colorado, 1968), 384.; Kutzleb cites Stuart Henry after this statement and quickly moves on to another topic. Stuart Henry comments that viewing the world through scripture was a "hurried idea" in a hurried time when the government and scientists did not have all of the answers for climate change and agriculture. The Bible, Henry noted, was "the only book, we may say, that had been read at all by pioneers on the Plains." Thus climate change "shared in the notion of haste."; Stuart Oliver Henry, *Conquering Our Great American Plains: A Historical Development* (New York: E.P. Dutton & Co., 1930), 235-236, 330-331.; The pairing of science and scripture has not been given enough attention as a serious consideration in relation to climactic change and the malleable West.

Western settlers and emigrants could have believed any number of things about the timescales of environmental change in the West, but it is clear that with the discovery of a malleable earth through geohistory, it was more plausible that radical changes could occur on the face of the planet.[18] Perhaps these changes could be favorable or even Providential. For some, the desert itself was a blessing since its soils were fertile and left waiting for clever exploitation. In the minds of many nineteenth-century Americans, science and technology strengthened Providence in resurrecting the garden-West.

The power of the human imagination is not always burdened with the constraints of material reality. Humans can envision alternate worlds and attempt to enact their vision in their material environment. In the arid West, hope for a better future often overrode observed environmental conditions and climactic trends. For boosters, this tendency was especially prevalent because it served their economic ends. However, visions for a better future arise from elements of perceived reality. Scientists spoke for the natural world and provided information that fed the envisaging of alternative environments. It was the prerogative of many optimistic westerners to pick and choose which observed facts and scientific theories accorded with their worldview. [19] Be it

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[18] James Fleming stated, "[n]ineteenth-century climatologists could find no trends in the weather records beyond variability and temporarily quashed the notion that humans can influence climate. Yet by mid-century, geologists had discovered great changes, ice ages and interglacial epochs, in the record of the rocks. The two timescales (the human historical and the geological) and the two agencies (anthropogenic forces and natural forces) were reunited in a new form at the dawn of the twentieth century by the Swedish meteorologist Nils Gustaf Ekholm (1848-1923), who wrote about 'the climate of the geological and historical past.'" However, I believe that this situation did not just occur at the turn of the twentieth century, it happened earlier. It occurred during the decades following the Civil War in the United States and contributed to hopeful theories of climate change in what had been known as "The Great American Desert."; James Rodger Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control* (New York: Columbia University Press, 2010), 4.

[19] John L. Allen, "The Garden-Desert Continuum: Competing Views of the Great Plains in the Nineteenth Century," *Great Plains Quarterly* 5, no. 4 (1985): 217.; Linda Nash, "The Agency of Nature or the Nature of Agency?" *Environmental History* 10, no. 1 (2005): 67-69.; Wallace Stegner, *Beyond the Hundredth*

through a geological or biblical history of the West, Americans saw the region's future through its past. The material remains of the deep past played a vital role in how the west was won. The desert-West was conquered using fossil fuels and scientific evidence of the changing character of the region. Powered by a faith in progress fed by fossil fuels the past of the western plains was used and fit into an imagined future full of prosperity.

Through the works of Ferdinand Vandeveer Hayden, Richard Smith Elliott, Cyrus Thomas, Samuel Aughey, Charles Dana Wilber, William Babcock Hazen, Grove Karl Gilbert, and John Wesley Powell this chapter will demonstrate the geological character of western climate change theories such as rain follows the plow and how opposition to these visions were difficult to demolish due to their basis in the earth sciences. This will show how these theories were backed by the same USGS survey science that was being performed to take advantage of the natural wealth of the West. It will thereby illustrate how western settlement was affected by the North American continent's geologic history. The geology of the West was used to support its changing character. Those who did not muster it were convinced of its static barrenness. Others who called upon it could not reject the possibility of a progressively changing climate. Some did this enthusiastically, while others were more conservative. Nevertheless the geology of the West provided scientific encouragement to theories of progressive climactic change such as rain follows the plow.

Meridian: John Wesley Powell and the Second Opening of the West (New York: Penguin Books, 1992), 238.; Walter Prescott Webb, *The Great Plains* (Boston, MA: Ginn, 1959), 375.

The USGS Surveys and the Geology of Climate Change: Rejecting the Desert through Ancient Environments

The Great American Desert had to be acknowledged as a physical reality in order for the theories of redeeming the West to gain traction.[20] The West had to be arid in order to be remade into a garden. Like all stories of redemption, they had to begin with despair.[21] The desert did not simply exist in the mind. It was not just a mistake of an incompetent set of early explorers. In the face of the arid reality of the West, and its alien nature in the eyes of easterners, the Great American Desert had actually existed. Its presence, however, was only temporary. The desert's death was heralded by the rise of a banner reading "Rain Follows the Plow."[22] Marching under this banner, the desert disappeared before the eyes of settlers and a garden was unearthed.

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[20] B.H. Baltensperger, "Plains boomers and the Creation of the Great American Desert Myth," *Journal of Historical Geography* 18, no. 1 (1992): 59-73.; David M. Emmons, *Garden in the Grasslands: Boomer Literature of the Central Great Plains* (Lincoln, NE: University of Nebraska Press, 1971), 130, 149.; Henry Nash Smith, "Rain Follows the Plow: The Notion of Increased Rainfall for the Great Plains, 1844-1880," *Huntington Library Quarterly* 10, no. 2 (1947): 172.

[21] William Cronon, "A Place for Stories: Nature, History, and Narrative," *The Journal of American History* 78, no. 4 (1992): 1347-1376.

[22] Smith, "Rain Follows the Plow,"170.; It is often stated by historians that the first published full expression of this theory was by Josiah Gregg in his 1844 work *Commerce on the Prairies*. Here he stated, "The high plains seem too dry and lifeless to produce timber; yet might not the vicissitudes of nature operate a change likewise upon the seasons? Why may we not suppose that the genial influences of civilization – that extensive cultivation of the earth – might contribute to the multiplication of showers, as it certainly does fountains? Or that the shady groves, as they advance upon the prairies, may have some effect upon the seasons? At least, many old settlers maintain that the droughts are becoming less oppressive in the West. The people of New Mexico also assure us that the rains have much increased of latter years, a phenomenon which the vulgar superstitiously attribute to the arrival of the Missouri traders. Then may we not hope that these sterile regions might yet thus be revived and fertilized, and their surface covered one day by flourishing settlements to the Rocky Mountains?"; (Josiah Gregg, *Commerce of the Prairies: Or, the Journal of a Santa Fé Trader, During Eight Expeditions across the Great Western Prairies, and a Residence of Nearly Nine Years in Northern Mexico* (New York: H. G. Langley, 1844), 202-203.); Mike Foster, *Strange Genius: The Life of Ferdinand Vandeveer Hayden* (Niwot, CO: Roberts Rinehart Publishers, 1994), 182.; Kutzleb, "Rain Follows the Plow: The History of an Idea," 37.

Optimism and the rising authority of science helped to make western climate change theories a prominent feature of widely circulated published material.[23] Though many historians reject the scientific character of the theory, it was nonetheless championed by respected nineteenth-century scientists.[24] The examples that follow in this section are taken from the United States Geological Survey (USGS) of the Territories reports published in the decade following the Civil War, which contained writings from respected scientists. As scientists surveyed the frontier, they were looking for the ways in which nature functioned and at the same time they were thinking about how humans fit into that world's past and future.[25] In the eyes of a number of the survey contributors, the West's geologic past provided proof of its garden qualities. The soils would bear fruit,

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[23] Emmons, *Garden in the Grasslands*, 130; For one of the most complete histories of the theory, see: Kutzleb, "Rain Follows the Plow: The History of an Idea."

[24] Henry Nash Smith regarded the theory less scientific than "social in character." Also, David Emmons noted, "That it enjoyed the endorsement of some reputable men is evidence not of its scientific credibility but of the urgency with which the American people approached the settlement of the Plains."; Smith, "Rain Follows the Plow," 174.; Emmons, *Garden in the Grasslands*, 141. ; Yet, this does not negate the scientific character of the theory. As the historiography of the history of science has aptly shown, science is in fact social in character. Also, a more recent analysis judged that "if they [theories of increased rainfall] are placed into the context of the limited climate and agricultural information at hand, they are understandable as responses to observed conditions."; Gary D. Libecap and Zeynep Kocabiyik Hansen, ""Rain Follows the Plow" and Dryfarming Doctrine: The Climate Information Problem and Homestead Failure in the Upper Great Plains, 1890-1925," *The Journal of Economic History* 62, no. 1 (2002): 88.; Furthermore, it is worth noting that one of American science's most prominent figures, Joseph Henry of the Smithsonian Institution, regarded the theory as scientifically plausible enough to publish in his institution's primary publication. He had, however, formerly believed the West to be too arid and "unfit for agriculture." Henry was intimately familiar with meteorological science and had performed scientific work concerning that topic. Hayden had accepted Henry's theory of western climates as related to the Rocky Mountains when considering the treelessness of the Plains (essentially describing the effects of a rain shadow). He was called a "typical geophysicist" by Nathan Reingold, who was the first editor of the Henry's papers. It was the work of Richard Smith Elliott that was accepted to be published in the Smithsonian's *Annual Report* in. Also, the American Association for the Advancement of Science judged theories of increasing rainfall as worthwhile for discussion at one of their meetings.: Fleming, *Meteorology in America*, 21, 127-128.; Foster, *Strange Genius*, 183.; Ferdinand Vandeveer Hayden, "Sketch of the Geology of the Country About the Headwaters of the Missouri and Yellow Stone Rivers," *The American Journal of Science* XXXI, no. 22 (March 1861): 245.; Nathan Reingold, "Cleveland Abbe at Pulkowa: Theory and Practice in the Nineteenth Century Physical Sciences," *Archives internationals d'histoire des sciences* 17 (1964): 144-145.; Smith, "Rain Follows the Plow," 174, 180.

[25] Sharon E. Kingsland, *The Evolution of American Ecology, 1890-2000* (Baltimore, MD: Johns Hopkins University Press, 2005), 15.

grow trees, and support agriculture. This section will use the work of Ferdinand Vandeveer Hayden, Richard Smith Elliott, and Cyrus Thomas to demonstrate the geological nature of western climate change theories.

In 1855, Lieutenant G. K. Warren and Hayden explored the "Dacota Country." In the report that followed can be seen the germs of how Hayden saw the future of the West through its geology. Here Hayden followed the Missouri River and while travelling through this region he did not see a desert west of the Mississippi. Instead, he saw plenty of coal and "an inexhaustible fertility, as the vegetation indicates, with a subsoil composed of a mixture of the calcareous and silicious marls of the Tertiary, and the clays of the Cretaceous."[26] The fertility of the land was directly related to its watery geologic past. The lands were so fertile that a farmer was confidently engaged in growing wine grapes.[27]

No simple piece of booster writing, Hayden sought to accurately assess the land's potential, admitting that the land's geological past could also render it sterile. For, as Hayden explained as he proceeded along his route up the Missouri, "the soil of this country begins to look less favorable for agricultural purposes, composed mostly of the clays of the Cretaceous system."[28] Areas along his route were "sterile in the extreme" and devoid of the characteristics amenable to agriculture.[29] And yet as he progressed up river,

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[26] G.K. Warren, *Explorations in the Dacota Country in the Year 1855,* 34th Congress, 1st Session, Ex. Doc. No. 76 (Washington: A.O. P. Nicholson, Senate Printer, 1856), 68, 73.
[27] Warren, *Explorations in the Dacota Country in the Year 1855,* 69.; Interestingly enough, the Champagne region of France is known for its Cretaceous soils that are complimented with lignitic soils from the Tertiary.; Robert E. White, *Soils for Fine Wines* (New York: Oxford University Press, 2003), 19-20.
[28] Warren, *Explorations in the Dacota Country in the Year 1855,* 70.
[29] Warren, *Explorations in the Dacota Country in the Year 1855,* 70.

the land continued to contain oases of timber and fertile soils for future settlement.[30] Hayden held a guarded optimism concerning the future settlement of these lands. While it was sterile in spots, the land held assured promise in its "inexhaustible" resources and soils derived from the Cretaceous and Tertiary.

Hayden's understanding of this geological evidence evolved after the Civil War. After unearthing ever more fossils in the West, he believed that the region had great potential for settlement because of its deep past. The fossil forests he found figured into his vision for the future forests of the West that would support settlement. In what would become the first of the USGS surveys of the Territories, he followed through on his promise to seek out coal for Nebraska's citizens. While pondering a coal seam found during his survey, he stated:

> [D]uring the Tertiary period, when the lignite…beds were deposited, all these treeless plains were covered with a luxuriant growth of forest-trees…now found only in tropical or sub-tropical climates…We are daily obtaining more and more evidence that these forests may be restored again to a certain extent.[31]

In this same report, he also followed a variant of the rain follows the plow thesis that focused on the climate-altering effects of tree planting.[32] He saw evidence that "[t]he settlement of the country and the increase of the timber have already changed for better

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[30] Warren, *Explorations in the Dacota Country in the Year 1855*, 72-79.
[31] Ferdinand Vandeveer Hayden, *First, Second, and Third Annual Reports of the United States Geological Survey of the Territories for the years 1867, 1868, and 1869: Annual Report of the United States Geological Survey of the Territories* (Washington, DC: Government Printing Office, 1873), 14.
[32] Gerald Davidson et al., "Gleanings from H-West: Rain Follows the Plow," *Montana: The Magazine of Western History* 49, no. 4 (1999): 92-95.; Charles R. Kutzleb, "Can Forests Bring Rain to the Plains?," *Forest History* 15, no. 3 (1971): 14-21.; Libecap and Hansen, ""Rain Follows the Plow" and Dryfarming Doctrine," 86-120.; Smith, "Rain Follows the Plow," 169-193.; For a general treatment of meteorological science in America, see: James Rodger Fleming, *Meteorology in America, 1800-1870* (Baltimore, MD: Johns Hopkins University Press, 1999).

the climate" and "rain has gradually increased in quantity." Hayden was "confident this change will continue to extend across the dry belt to the foot of the Rocky Mountains as the settlements extend and the forest-trees are planted in proper quantities." This climactic change would even end the plagues of grasshoppers that regularly wreaked havoc on the fruits of farmer's toil. In order to provide support for his claims, Hayden was sure to state, "these ideas are not purely theoretical" and "have been investigated by some of the ablest scientific men in this country and Europe."[33] The West's malleability was a scientific fact supported by its geological past and its recent settlement.

After unearthing fossils in the West, Hayden believed that the region had great potential for settlement because of its deep past. The fossil forests he found figured into his vision for the future forests of the West that would support settlement. Hayden believed that his reports should be of use to the public since they were publically funded.[34] To this restorative end and as a public service, he consistently documented all coal deposits, grazing lands, areas for resorts, irrigation sites, timber stands, and every relevant resource for a growing country high on Manifest Destiny.[35] Hayden had lent scientific support to the idea that the western environment could be manipulated by human hands and restored to a former state that would be more amenable to agricultural settlement. He thereby became one of the first paleo-restorative dreamers.

The scientific study of the American West's ancient verdant environments lent convincing support to the long-held belief of the West as a garden. This paleo-restorative

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[33] Hayden, *First, Second, and Third Annual Reports*, 14-15.
[34] Marlene Merrill, *Yellowstone and the Great West: Journals, Letters, and Images from the 1871 Hayden Expedition* (Lincoln, NE: University of Nebraska Press, 1999), 6.
[35] Cassidy, *Ferdinand V. Hayden*, 81-105.

dream was echoed in the 1867 "Report of the Commissioner of General Land Office" that stated:

> It is reported by the geologist that sufficiently numerous experiments have been made to demonstrate the fact that forests, in comparatively briefly periods, may be restored to the almost treeless prairies of the west. It is supposed that during the time the brown coal-beds were deposited all these treeless plains were covered with a luxuriant growth of forest trees, like those of the tropical and sub-tropical climates, such as palm trees, gigantic sycamores, maples, poplars, cedars, hickories, cinnamon, and fig trees; large portions of the upper Missouri being now covered with the silicified trunks of trees of huge dimensions, exhibiting the annual rings of growth with great distinctness.[36]

The General Land Office was created in 1812 with the purpose of managing and disposing of public lands. Its report served to summarize the nature of the land held by the United States. Hayden's vision was deemed relevant enough to include in this report and was lent further credibility through the reference to "geologists" who have experimented on this notion and concluded its veracity. Thus, in Hayden's estimation and that of the General Land Office, the fossilized remains of ancient forests were of relevance to the general public who also dreamed of reclaiming the West from the persistent Great American Desert.

Richard Smith Elliott's "Report on the Industrial Resources of Western Kansas and Eastern Colorado" in the second USGS report affirmed the contention that human action could indeed alter the very climate of the West. Hayden's role as western booster and friend to the railroads is evident in his reception and approval of Elliott's report. Elliott was at that time in the employ of the Kansas Pacific Railroad (KPRR) as its very

[36] United States General Land Office, *Report of the Commissioner of General Land Office, for the Year 1867* (Washington, DC: Government Printing Office, 1867), 89.

first "Industrial Agent."[37] It is not surprising, therefore, that his view of the future prospects for western Kansas and eastern Colorado where the KPRR held high hopes for settlement was decidedly positive. Elliott knew that audiences reading these surveys would be interested in climate change.[38] Consequently, he wrote a subsection titled "Change of Climate," in which he stated that there are "[f]acts" that "sustain the popular persuasion in Kansas, that a *climactic change* is taking place, promoted by the spread of settlements westwardly." The cause, according to Elliott seemed to be anthropogenic. He reported that by breaking up the soil, planting shade-bearing flora, and the "extension of the railroads and telegraphs" the "rains and humidity of the Plains have increased." These causes could clearly be traced to the providential effect of western settlement. Or, Elliott hypothesized, it was due to a "mysterious electrical influence" associated with these technological developments, or simply "that wet seasons have merely happened to coincide with the railroads and telegraphs." Nevertheless, he assured his audience, "[i]t is certain that rains have increased; this increase has coincided with the extension of settlements, railroads, and telegraphs. If influenced by these, the change of climate will go on." Elliott had faith that the West was plastic. The climate of the West was incidentally improving through the technologies and agricultural acts of settlers.[39]

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[37] Cassidy, *Ferdinand V. Hayden*, 125.

[38] The change in climate that Elliott and many settlers desired is not to be confused with today's climate change, which is largely described in negative terms. However, it is interesting to note that both are often associated with anthropogenic causes and the environmental consequences of technology.

[39] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 455-456.; In this section of his report, Elliott quoted from a letter sent to Joseph Henry of the Smithsonian Institution where he explained his ideas. His ideas were then published in the Smithsonian's scientific publication and were talked about in a positive light at a meeting of the American Association for the Advancement of Science.: Smith, "Rain Follows the Plow," 174.; For more information on his role in advancing the theory for the railroads, see: Foster, *Strange Genius*, 182-183.; Kutzleb, "Can Forests Bring Rain to the Plains?," 16; Kutzleb, "Rain Follows the Plow: The History of an Idea," 45-48.; See also Elliott's autobiograhy: Richard

Even if the climactic impact of the telegraph and railroad were to fail, Elliott provided a plan to ensure the agricultural future of the West. This plan called upon the deep past. Referencing the work of geologists and paleontologists, Elliott advanced the dream of paleo-restoration. Using science performed concerning the Cretaceous West, he concluded:

> The fossil wood, imbedded in the cretaceous strata in many parts of the Plains, is left out of consideration, as belonging to a previous, though recent, geological age; but the single specimens of trees found at wide intervals are silent witnesses to the *possibility* of extended forest growth. These living trees suggest at once, by their location, the feasibility of their increase, and the *reason of their scarcity*.[40]

His plan to restore these Cretaceous trees could be accomplished by breaking up the soil "to a depth of two feet" and thereby encouraging the growth of "taller herbage." In Elliott's estimation, a "single year would witness a changed vegetation and a new climate." His claims conclude the narrative content of the entire survey report.[41] Its

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Smith Elliott, *Notes Taken in Sixty Years* (St. Louis, MO: R. P. Studely & Co., Printers, Lithographers and Stationers, 1883).; Smith, "Rain Follows the Plow," 176.; Emmons, *Garden in the Grasslands*, 142-147.

[40] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 455-457.; Ferdinand Vandeveer Hayden, *Preliminary Report of the United States Geological Survey of Montana, and Portions of Adjacent Territories; Being a Fifth Annual Report of Progress for the Year 1871* (U.S. Government Printing Office, 1872), 279.; Elliott's commentary on the effect of settlement on the climate from the second report is essentially repeated in this fifth report. It is accompanied by descriptions of experimental projects in cultivation in Kansas. It directly precedes the paleontology section.Elliott's statements were also repeated in William E. Webb's *Buffalo Land*.; William E. Webb, *Buffalo Land: An Authentic Account of the Discoveries, Adventures, and Mishaps of a Scientific and Sporting Party in the Wild West* (Chicago, IL: E. Hannaford & Company, 1872), 485.; H. Craig Miner, *West of Wichita: Settling the High Plains of Kansas, 1865-1890* (Lawrence, KS: University Press of Kansas, 1986), 42.

[41] During the late nineteenth and early twentieth centuries, forests were considered a crucial element for the future of agriculture and for enacting climactic changes in the West. For more information, see: Thomas R. Cox, *This Well-Wooded Land: Americans and Their Forests from Colonial Times to the Present* (Lincoln, NE: University of Nebraska Press, 1985).; Brian Allen Drake, "Waving "a Bough of Challenge"; Forestry on the Kansas Grasslands, 1868-1915," *Great Plains Quarterly* 23 (Winter 2003): 19-34.; Wilmon Henry Droze, *Trees, Prairies, and People: A History of Tree Planting in the Plains States* (Denton, TX: Texas Woman's University, 1977).; David M. Emmons, "Theories of Increased Rainfall and the Timber Culture Act of 1873," *Forest History* 15, no. 3 (1971): 6-14.; Robert C. Gardner, "Technological Forests:

placement at the conclusion of paleontological descriptions that illustrate great climactic and environmental changes leaves the reader with the impression that the environment is indeed quite plastic. The citizen thinking about settling in the West could rest assured that the vision of lands west of the 100th meridian as the Great American Desert was premature and a reflection of a temporary state of the western lands.

Like many of his contemporaries, another contributor to Hayden's reports, Professor (and Reverend) Cyrus Thomas, had faith in the agricultural potential of the West.[42] Thomas was well regarded as a scientist and when asked about his credentials in 1870, Spencer Baird informed Hayden of his abilities.[43] In the fifth USGS report, Thomas was sure to note the important work of Elliott:

> The industrial agent of the Kansas Pacific Railroad is trying the experiment of growing forest trees on the plains without irrigation. It is to be hoped that this will not be given up until it is thoroughly tested; and I would suggest that although the experiment may not succeed along the whole length of the belt across the plains, yet it is of vast importance, should it fail in part, to know how far west it is possible to encroach upon the plains. If an inch can be permanently gained by the first experiment, an ell may be gained by perseverance.[44]

Engineering Nature with Tree Planting on the Great Plains, 1870-1965," (PhD diss., Montana State University, 2013).; Kutzleb, "Can Forests Bring Rain to the Plains?,"14-21.; George Perkins Marsh, *Man and Nature: Or, Physical Geography as Modified by Human Action* (New York: C. Scribner, 1864).; Joel J. Orth, "Directing Nature's Creative Forces: Climate Change, Afforestation, and the Nebraska National Forest," *The Western Historical Quarterly* 42, no. 2 (SUMMER 2011): 197-217.; Michael Williams, *Americans and Their Forests: A Historical Geography* (New York: Cambridge University Press, 1989).

[42] Emmons, *Garden in the Grasslands*, 131-133.; Foster, *Strange Genius*, 181-182.; Kutzleb, "Rain Follows the Plow: The History of an Idea," 55-58.

[43] Letter from Spencer Baird to Ferdinand Vandeveer Hayden, February 11, 1870, Smithsonian Institution Archives. RU53, Microfilm Vol. 8, Reel 7.: Thomas was a polymath who studied law, religion, entomology, archeology, agriculture, and climatology.; "Prof. Cyrus Thomas," *The New York Times*, June 28, 1910.

[44] Hayden, *Preliminary Report of the United States Geological Survey of Montana*, 225.

Thomas was skeptical but hopeful that this experiment would work in the West.[45] In the sixth USGS report, Thomas' section on the "Physical Geography and Agricultural Resources of Minnesota, Dakota, and Nebraska," contained a letter of submittal that summarized his vision for this section of the country. "As a summary of results," Thomas wrote Hayden, "I may state that, although in some respects the portion of our country visited did not meet entirely my expectations, founded on the exaggerated and glowing descriptions and others interested, yet it presents a bread-producing area equaled by but few and surpassed by none on the continent."[46] Seeing the land with his own eyes, Thomas no longer accepted the inflated rhetoric that characterized western boosterism.

Yet, the land held promise. In fact, Thomas added, "[i]ts capacity as a wheat-growing section is immense; so great, in fact, that the figures stagger our belief when first presented."[47] The climate that supported this region covered with waves of wondrous wheat, Thomas concluded, was "the effect of the last geological change that took place in the surface."[48] He conceded that this theory was in its infancy, but that a crucial question must be answered. Owing to the geological evidence of the "great change" that "has taken place in the climate in regard to humidity; that it is much less now in the western portions of Dakota, Nebraska, and Kansas than it was in the past. This question then arises: Has the change in this direction ceased?"[49]

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[45] For more information on Elliott's attempts to grow trees and agricultural products in Kansas, see: Miner, *West of Wichita*, 42-44.
[46] Ferdinand Vandeveer Hayden, *Sixth Annual Report of the United States Geological Survey of the Territories: Embracing Portions of Montana, Idaho, Wyoming, and Utah; Being a Report of Progress of the Explorations for the Year 1872* (Washington: U.S. Government Printing Office, 1873), 276.
[47] Hayden, *Sixth Annual Report of the United States Geological Survey of the Territories,* 276.
[48] Hayden, *Sixth Annual Report of the United States Geological Survey of the Territories*, 278.
[49] Hayden, *Sixth Annual Report of the United States Geological Survey of the Territories*, 279.; Cyrus Thomas had accepted that rain was following the plow in the West. However, by the late 1880s, Thomas

Plans for future settlement in the West depended on knowing if the climate was becoming drier or if a favorable change was on the horizon whereby a climactic reversal would help drive agricultural pursuits and profit farmers on the western plains. His opinion on this matter can be seen in remarks that he made five years previous. Under the employ of Hayden, Thomas declared in the first USGS report that the climate around Denver showed signs of improvement as a result of settlement. "It is a common expression of the Mexicans and Indians," Thomas recounted, "that the Americans bring rain with them."[50] He admitted that the subject needed more study, but that he essentially agreed with this folk knowledge.

> All this, it seems to me, must lead to the conclusion that since the Territory has begun to be settled, towns and cities built up, farms cultivated, mines opened, and roads made and traveled, there has been a gradual increase in moisture. Be the cause what it may, unless it is assumed that there is a cycle of years through which there is an increase and that there will be a corresponding decrease, the fact must be admitted upon this accumulated testimony. I therefore give it as my firm conviction that this increase is of a permanent nature, and not periodical, and that it has commenced within eight years past, and that it is in some way connected with the settlement of the country; and that, as the population increases, the amount of moisture will increase.[51]

The government and the railroads, Thomas proclaimed, should use this knowledge to "set the great power in motion which, moving onward, would ultimately bring into use that

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was in the employ of John Wesley Powell and had, like many others, regretted that he had subscribed to such a belief.; Stegner, *Beyond the Hundredth Meridian*, 298.

[50] Hayden, *First, Second, and Third Annual Reports*, 237.; The supposed Native American belief that rain follows white settlers was repeated in other publications such as the *New York Tribune*.; Kutzleb, "Rain Follows the Plow: The History of an Idea," 66.

[51] Hayden, *First, Second, and Third Annual Reports*, 237.

vast body of land which by common consent has been consigned to perpetual inutility."[52] The land was malleable, and it should not be resigned to sit dusty and unused. White civilization and technology would bring the rains and revive this thirsty land.[53]

Optimistic as these reports were, they could not ignore the powerful image of the Great American Desert. In his second report, Hayden assured his readers that "every year as we know more and more of the country this belt becomes narrower and narrower, and as a continuous area it has already ceased to exist, even in the imagination."[54] Admittedly, Hayden conceded, the West contained some stretches of sterile aridity. But even these uninhabitable regions held promise for "intelligent men" seeking "far-famed bone deposits."[55] Furthermore, like the lack of forests, the arid lands could simply be a temporary phase of the malleable earth. Hayden shared the sentiments of Thomas – rain would come to the West:

> There is another point that may be worthy of note here, and that is the prevailing impression among all the inhabitants of the West of a gradual change of climate by settlement and the cultivation of the soil. It is true, that over a width of one hundred miles or more along the Missouri River the little groves of timber and extending their area; that springs of water are continually issuing from the ground where none were ever known before; and that the distribution of rain throughout the year is more equable. Such being the case, time may work important changes, and settlements may at some time cause a large portion of that belt which hitherto been regarded as given up to sterility to become of value for the abode of man.[56]

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[52] Hayden, *First, Second, and Third Annual Reports*, 237.
[53] Wallace Stegner believed that Thomas likely regretted his statements on behalf of rain follows the plow as the century advanced and he became a part of Powell's surveys.: Stegner, *Beyond the Hundredth Meridian*, 298.
[54] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 103.
[55] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 104.
[56] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 104.

Hayden did not offer data to support his assertion, nor did he call upon a particular scientific paper as the basis for this claim. Hayden instead turned his attention directly to the paleontology and geology of western regions where there were "grand cemeteries of extinct animals which have excited the wonder of intelligent men all over the world."[57] His placement of the geological history of the West was rhetorically conspicuous and did work to lend support for a changing environment. Two pages later he explicitly stated this fact. "Ever since the commencement of creation," Hayden explained, "constant changes of form have been going on in our earth."[58] The USGS reports were a portal for Hayden's confident conviction of a changing climate to be accessed by the public.[59] These reports lent scientific merit to what could have remained a folk belief held by Mexicans, Native Americans, and hopeful agriculturalists.

Hayden's vision afforded the geologic past a considerable amount of agency in creating conditions for successful future settlement. In 1872, the summation of his vision came to light in four pages of the second USGS survey of the Territories report that pertain to Nebraska. Hayden began by stating that "the eye of the observing traveler" would be sure to notice "the marvelous fertility of all this region."[60] Underlying this

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[57] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 104.
[58] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 106.
[59] Emmons, *Garden in the Grasslands*, 130-132.; Kutzleb, "Rain Follows the Plow: The History of an Idea," 53-55, 86.; Smith, "Rain Follows the Plow," 178-179.: Historian Mike Foster, a sympathetic biographer of Hayden, claimed that while they gave the theory support, "[n]either Hayden nor Thomas made any commitment to the veracity of the theory, and neither used it irresponsibly, as some promoters did, to stimulate western migration. Both men simply called attention to empirical evidence that seemed to support an interesting theory, and both insisted, whenever discussing agriculture on the plains, that irrigation would be necessary for successful crops." In fact, Foster believed that historians had been too quick to attack Hayden for his promotion of "Rain Follows the Plow." The way that Foster saw it was that, "[j]udged y what was known at the time, however, Hayden behaved quite responsibly. By bringing public attention to the matter he undoubtedly stimulated scientific testing of the theory."; Foster, *Strange Genius*, 181-183, 377-378.
[60] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 98.

fertility was the watery past of the region since "[t]here seems to be evidence that the ocean or a lake once extended up the valley of the Mississippi, and up the Missouri beyond the reach of tidal influences nearly to Fort Pierre."[61] Here, he found evidence of Mastodons as well as extinct shelled creatures from "far back in the past before the existence of man on this continent."[62]

Anticipating his reader's inevitable inquiry, Hayden stated, "[t]he traveler will very naturally inquire, why, with all this wonderful fertility of soil, these broad, grass-covered plains do not contain a suitable supply of forest trees." Repeating his paleo-restorative dream that came out of his 1867 report, Hayden explained, "the time is not very distant when portions of the country will be covered with beautiful artificial forests, and we will attempt to show that this is only a restoration of conditions that once existed in the geological past."[63] The return of forests would herald the change in climate. Geology spoke of a West that would look like the familiar pastoral regions of the East.

As it had long ago (how long ago was still subject to debate), the West was changing. It was malleable according to the geological history being written by scientists and provided to the public in USGS reports. According to Hayden, Elliott, and Thomas, not only could nature enact changes to the landscape and climate, but the onward march of providential progress, technologies of conquest, and western migration granted humans the capacity to become partners with nature's transformative powers. Settlers and the westward gazing public longing for a fruitful future could rest assured that, according to science, nature was on their side.

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[61] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 98.
[62] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 99.
[63] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 99.

The Revival of the Garden West and the Media: The Geological Basis for Rain Follows the Plow Meets its Admiring Public

Scientists lent authority to the hopeful hypothesis because, as a class of specialists, they were fast becoming prominent figures in industrial America.[64] Their testimony and the pervasive presence of climate change theories in the media and in the hands of popularizers gave settlers faith that human hands and the fossil-fueled technologies of civilization were destined to naturally reclaim the desert.[65] Sustained on scientific support and eternal optimism, the theory was accepted by a wide audience and was thereby influential in the settling of the American West and delaying the adoption of technological or scientific options (such as irrigation, reclamation, and dry farming that will be discussed in Chapter 8) for creating western agricultural opportunities.[66] Through America's newspapers, the popularized work of Hayden, the soil science of Samuel Aughey, and the boosting work of Charles Dana Wilber who coined the phrase "rain follows the plow," this section will examine how the geological basis of western climate change was broadcast to the public.

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[64] Davidson et al., "Gleanings from H-West: Rain Follows the Plow," 93.; Smith, "Rain Follows the Plow," 176.

[65] Kutzleb, "Rain Follows the Plow: The History of an Idea," iv.

[66] Historian Charles Kutzleb believed that the theory was important and influential, but it is crucial to note that it may be impossible to know for sure exactly how significant the theory was in the decisions made by settlers and policy makers. Therefore, Kutzleb stated, "the belief was important, but it would be misleading to contend that the idea was a major factor in the minds of settlers on the Plains." Also, Henry Nash Smith came to a similar conclusion in his article on the theory. However, the data used by Smith was a very limited sample that cannot definitely prove the popularity or lack of significance of the theory.; Emmons, *Garden in the Grasslands*, 130.; Kutzleb, "Rain Follows the Plow: The History of an Idea," iv, 1, 377, 388-391.; Kutzleb, "Can Forests Bring Rain to the Plains?," 19-21.; Smith, "Rain Follows the Plow," 189-191.

Theories of climate change held the attention of Americans since colonial times.[67] Rain follows the plow was one eventual articulation of the many theories espoused concerning anthropogenic climate change.[68] Due to the agricultural dreams of America after the Civil War, the theory took an unprecedented hold on the public's imagination.[69] Up until the 1890s, this theory circulated widely and the process of reclaiming the West was thought to be a natural process that occurred incidentally or providentially in the wake of Euro-American technological and agricultural civilization. As such, the theory carried with it elements of geologic history that helped lend support to an ever-changing natural world. The Earth's climate had changed and would change again to suit America's growth. The changing Earth would yield favorable conditions because humankind had a natural dominion over the rest of creation, and it was America's Manifest Destiny to conquer the western wilderness.[70] The secrets to manipulating the land were to be found in the earth. The Earth provided the blueprint and means for a better West. One only had to use the Earth's resources and read its history in order to live comfortably on its surface. It showed a marvelously malleable region that held the potential for untold agricultural success. Material remains of extinct plants and animals and the authority of science supported these statements.

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[67] The effects of clearing trees and the effects of climate on health (medical geography or topography) were of particular interest. See: Fleming, *Meteorology in America, 1800-1870*, 1, 2, 5-7, 21; Conevery Bolton Valenčius, *The Health of the Country: How American Settlers Understood Themselves and Their Land* (New York: Basic Books, 2002).

[68] Kutzleb, "Rain Follows the Plow: The History of an Idea," 24-30.; For example, the agricultural advocate Thomas Jefferson believed that in an early variant of the theory.; Fleming, *Meteorology in America, 1800-1870*, 3-4; *Fixing the Sky*, 7; James Roger Fleming, *Historical Perspectives on Climate Change* (New York: Oxford University Press, 1998). 19, 26, 29.

[69] Emmons, *Garden in the Grasslands*.; Gilbert Courtland Fite, *The Farmers' Frontier, 1865-1900* (New York: Holt, 1966).; Thomas R. Wessel, *Agriculture in the Great Plains, 1876-1936*. (Washington: Agricultural History Society, 1977).

[70] Emmons, *Garden in the Grasslands*, 129; Smith, "Rain Follows the Plow," 172, 189.

In order for science to be necessary to prove climactic change, belief in a permanent desert-West had to be in decline. As Americans and survey scientists pushed into the frontier, more was known about its character through direct experience with its environment. It became clear not only that the western landscape had a history characterized by change, but that there was a significant degree of variability in the settlement potential of the West.[71] It was untenable to label the entire region as a desert and to think about its environment as fixed. The garden-West was ascending in the popular imagination before the Civil War as newspapers from western communities consistently carried stories that educated their audiences as to the erroneous notion of the Great American Desert.[72]

After the Civil War, newspapers continued to carry stories in increasing frequency that spoke of its fertile agricultural lands. Papers quoted from well-known figures such as William Gilpin who explained that the Great American Desert was a myth that must be discarded.[73] They also critiqued earlier scientist-explorers who had given the region a bad name. For example, in 1867, the ghost of the Great American Desert continued to capture attention as Nebraska native recalled reading an atlas that showed a desert west of the Mississippi where he imagined "even an Indian, with his pony's tail turned to the Desert,

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[71] William H. Goetzmann, *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West (*New York: Knopf, 1966).; Andrew Menard, "Striking a Line through the Great American Desert," *Journal of American Studies* 45, no. 02 (2011): 267-280.

[72] For example, see: "Great American Desert," *The Herald of Freedom*, July 14, 1855.

[73] For example, see: "The Great American Desert," *The Howard Union*, November 2, 1865.: Gilpin has been characterized by some historians as an advocate of "Rain Follows the Plow." It is definitely true that he sought to overturn the Great American Desert and that he saw the movement of the American people as a providential march across the continent. However, most histories of that particular theory do not include him as a major proponent. Gilpin vehemently denied that the Great American Desert existed. Because of this, he did not need a mechanism that ensured its malleability. For an example of a history that includes Gilpin as an adherent of the theory, see: Stegner, *Beyond the Hundredth Meridian*, 2-3.

was chasing off at top speed for a better locality."[74] The author admitted that he had "took a great amount of stock in this desert idea," but realized that it "grew out of the conceit of a lazy engineer, who got sick of the vast expense of chain dragging, and lumped the whole as a region not worth ten days work with chain and level." His reference to a "lazy engineer" is almost certainly Stephen Harriman Long who the author claimed "libelled the fairest wheat growing section in the world." Nebraska deserved to be "permanently redeemed" and the Great American Desert to "choke to death for ever."[75]

Rain follows the plow was a prominent feature of these news stories. For example, in 1874, an article about dividing Dakota Territory directly attacked the notion of the Great American Desert and stated that the railroad had come to the region and "[t]he climate has changed, rains are more frequent, the soil produces abundantly, young groves have sprung up, and that whole region is becoming an inviting field for immigrants."[76] Two years later, a paper from the same territory proposed that in Bismarck "rainfall increases year by year."[77] In 1878, the belief persisted and a Kansas newspaper confidently declared "The Great American Desert No Longer a Waste." It was not that the land had not been a barren wasteland at one point, but that "the ordinary and

[74] "The Great American Desert," *The Lincoln County Herald*, September 26, 1867.
[75] "The Great American Desert."; For other examples of newspaper articles addressing the error of the Great American Desert, see: "The Great American Desert," *Ashtabula Weekly Telegraph*, April 28, 1866.; "Brownville," *Nebraska Advertiser*, June 9, 1870.: There was also a tendency to celebrate the people who worked hard in the West in order to make it a garden. For example, William Jennings Bryan's famous "Cross of Gold" speech spoke highly of "those hardy pioneers who braved all the dangers of the wilderness, who have made the desert to blossom as the rose."; ("Bryan's "Cross of Gold" Speech: Mesmerizing the Masses," History Matters, George Mason University, accessed September 12, 2014, http://historymatters.gmu.edu/d/5354/.)
[76] "Proposed New Territory - Character and Resources," *The Bismarck Tribune*, April 15, 1874.
[77] "Bismarck," *Bismarck Weekly Tribune*, June 28, 1876.

effective forces of nature" were at work changing the character of the land. "Within the last ten years," observed the reporter, "there has been a wonderful climatic change, which is increased as improvements stretch westward, thus rendering a once barren, dry waste a soil rich and productive and a climate genial and temperate."[78] It was not simply the opinion of the reporter; this had "been witnessed or noted by thousands of the people of this State [Kansas]."[79] Through the progress of western settlement, the land would naturally unveil its plastic potential and provide for the wants and needs of agricultural and industrial society.

The newspapers were no doubt interested in advertising for the wonders of their western locales. However, it was not just the newspapers that embraced this idea. For example, scientists surveying the West found that they were not the only ones who saw the West as a fluid landscape. While traveling through Utah in 1870 as a member of Hayden's survey party, George Allen met with a farmer and his family where the party was "kindly treated to a bowl apiece of sour milk."[80] Allen engaged the kind family of four in conversation and was told that they had had seen some hard times over the years, but their situation had begun to improve.[81] Their hope was likely derived from their understanding of the changing climate of the West. This is evidenced by Allen's comment later in the entry where he wrote of the lack of sufficient precipitation in the area, and then stated, "[i]t is the impression here among the settlers that the climate is undergoing decided change – a change in every way favorable to the people. The warm

[78] "The Great American Desert No Longer a Waste," *Dodge City Times*, January 19, 1878.
[79] "The Great American Desert No Longer a Waste."
[80] Merrill, *Yellowstone and the Great West*, 66.
[81] Merrill, *Yellowstone and the Great West*, 66.

season is prolonged and frosts less severe."[82] The settlers, as well as Allen, believed that the once arid region was gradually becoming more habitable.[83]

The public was also offered a profusion of reading material that confidently declared the bounty of western lands. For example, building off of his scientific stature, Allen's student, Hayden, continued to offer up his vision of the West's potential. Around 1880, the publisher Charles R. Brodix contacted Hayden in order to grant authority to a popular examination of the West's attractions and resources.[84] The result was *The Great West*, which centered on Hayden's science-infused boosterism and clearly drew directly from his previous surveys. Hayden's significant scientific credentials were likely known to the public, but in case they were unaware of his status, he was identified on the title

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[82] Merrill, *Yellowstone and the Great West*, 67.

[83] Fluctuations in rainfall in the West during the 1870s and 1880s also likely encouraged views of a malleable West and possibly provided temporary support for beliefs such as rain follows the plow. The pairing of scientific evidence of the malleable West through fossilized remains lent further support to the observable changes that seemed to be taking place. The West had also seen a period of increased rainfall during the late 1860s, thereby adding to the folk knowledge of the changing climate. Faced with incomplete (or nonexistent) sets of climactic data for the western region previously known as "The Great American Desert," optimistic westerns chose to see the extreme climactic cycles in a positive light. The wet years weighed more heavily on the minds of hopeful agriculturalists than the droughts that occasionally interrupted their prosperity. In reality the plow followed the rain (cycles) and settlers flocked to the West during periods of wet weather. For more information, see: E.R. Cook and P.J. Krusic, "North American Drought Atlas: A History of Meteorological Drought Reconstructed from 835 Tree-Ring Chronologies for the past 2005 years," Lamont-Doherty Earth Observatory and the National Science Foundation, accessed September 30, 2014, http://iridl.ldeo.columbia.edu/SOURCES/.LDEO/.TRL/.NADA2004/.pdsi-atlas.html.; W. Eugene Hollon, *The Great American Desert Then and Now* (Lincoln: University of Nebraska Press, 1975), 147.; Kutzleb, "Rain Follows the Plow: The History of an Idea," 164-165.; Kutzleb, "Can Forests Bring Rain to the Plains?," 15.; Libecap and Hansen, ""Rain Follows the Plow" and Dryfarming Doctrine,".; Webb, *The Great Plains*, 376.; Mary W. M. Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925* (Cambridge, MA: Harvard University Press, 1957), 52-53.; Cary J. Mock "Rainfall in the Garden of the United States Great Plains, 1870-1889," *Climactic Change* 44 (2000): 173-195.; Smith "Rain Follows the Plow: The History of an Idea," 14, 99.; An example of this was presented by Kutzleb. Drought struck Kansas, Nebraska, and the Dakotas from 1873-4. This led to some questions about providence and the theory that rain followed the plow, but optimism prevailed and blame was cast upon the plague of grasshoppers that accompanied the drought. Even in the face of a brutal drought, many settlers maintained their optimism and the idea "continued to gain momentum.": Kutzleb, "Rain Follows the Plow: The History of an Idea," 69-75.; Kutzleb, "Can Forests Bring Rain to the Plains?," 15.

[84] Foster, *Strange Genius*, 327-328.

page as "Formerly United States Geologist." Also, an introductory note described his internationally recognized scientific expertise and extensive experience as an explorer of the West.[85] *The Great West* was directed at advancing settlement of the region and from its start addressed the misguided motives of the early migrants who sought riches. Instead, Hayden promoted the "wiser course of cultivating the earth."[86] In the eyes of one of Hayden's "Able Contributors," the West's "wilderness" was being made to "blossom as a rose" through "rapid settlement" by "thrifty and industrious" settlers.[87] How could this have happened? Hayden's *The Great West* regularly drew upon geology to comprehend the unique natural attributes that made the West a wondrous place for the nation's growing population.

Hayden's geological mind infused his writing about the West's potential. He recognized that in the increasingly industrial society of America, fuel was on the minds of potential settlers. Hayden could not deny that the West lacked timber, a traditional and ubiquitous fuel source in the East. The fossilized vegetation in the form of coal, Hayden assured his readers, would more than make up for this deficiency. "The scarcity of tree vegetation over the greater portion of our Western country," Hayden explained, "renders this coal [found in Colorado, Wyoming, Utah, Montana, and New Mexico] of vital

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[85] Ferdinand Vandeveer Hayden, *The Great West: Its Attractions and Resources. Containing a Popular Description of the Marvellous Scenery, Physical Geography, Fossils, and Glaciers of This Wonderful Region; and the Recent Explorations in the Yellowstone Park, "The Wonderland of America," by Prof. F.V. Hayden, LL.D., Formerly United States Geologist. Also, Valuable Information to Travellers and Settlers Concerning Climate, Health, Mining, Husbandry, Education, the Indians, Mormonism, the Chinese; with the Homestead, Pre-Emption, Land, and Mining Laws. By a Corps of Able Contributors. Handsomely Illustrated with Engravings and Maps* (Bloomington, IL: Charles R. Brodix, 1880), 5-6.
[86] Hayden, *The Great West*, 5.
[87] Hayden, *The Great West*, 88.

importance to the present and future industries of the great West."[88] While many of these coal deposits would have been too remote to be of use to settlers, Hayden revealed that the ever-expanding railroads made many of these sources available. In regards to the existence of the Great American Desert, Hayden used the exact passages quoted above from his second report to explain the region's diminishing aridity and the favorable climactic change that had followed the exploration and settling of the West.[89] Conspicuously, his claims about the changing climate are immediately preceded by references to the watery geologic history of the West.

If one was able to read the remains of the past, they would easily discover that the earth was malleable. "Ever since the commencement of creation," Hayden related to his readers, "constant changes of form have been going on in our earth. Oceans and mountains have disappeared, and others have taken their place."[90] The "infinite" nature of geological time, however, was unfathomable to most "finite minds."[91] These temporally expansive changes in the land had wrought conditions favorable to settlement.[92] The states of Kansas and Nebraska serve as examples of Hayden's geological boosting and recognition that the foundation of the West would be built on the products of the processes of deep time. In Hayden's chapter on Kansas, he began with brief reference to its geography and history and then quoted from Professor B. F. Mudge on the geology of the state. Mudge remarked that due to the geology of Kansas, it was

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[88] Hayden, *The Great West*, 82.
[89] Hayden, *The Great West*, 41-42.
[90] Hayden, *The Great West*, 45.
[91] Hayden, *The Great West*, 46.
[92] Two items were working against the unfathomable nature of geologic time. The first was discussed in Chapter 2. The use of fossil fuels made humans a geological agent and therefore beyond geologic time. The second was referred to in this chapter's introduction. Biblical time was short, and to those believing in scripture and the God-given national destiny of America, geologic time was irrelevant.

easily travelled, well-watered, and contained soil that was a "fine black, rich loam" in which "[t]he predominating limestones by disintegration aid in its fertility."[93] Coal was also "found in large quantities" to be used for domestic and industrial purposes.[94] Hayden followed with boosting the state's ranching and agricultural prospects. According to him, The Great American Desert was "erroneous" and Kansas had extremely little "waste land."[95] Kansas farms were "among the most fertile and productive in the West" and served by an "admirable network of railroads" that ensured their success.[96] Supported by its geology, the state had abundant coal, was linked into the nation's technological arteries that brought life to western towns, and had richly fertile land for future agriculturalists.

"In her agricultural productions Nebraska is rich," Hayden faithfully believed, "and will be richer." Nebraska "boasts soil that is nowhere excelled, a climate favorable to production, and pure water in abundance."[97] Hayden began his chapter on Nebraska with what he called "folk-lore." In this story a farmer digs around trees in his orchard looking for buried treasure. He is unsuccessful in locating riches, but in the process of breaking up the soil the man had made his orchard more productive. Hayden held fast to what have been termed pseudoscientific or folk beliefs regarding the changing climate of the West as settlers tilled the land and that also coincided with the growing populations of western towns. The basis of this theory lay with fertility of the land which was the product of the West's geologic past.

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[93] Hayden, *The Great West*, 261.
[94] Hayden, *The Great West*, 262.
[95] Hayden, *The Great West*, 268-269.
[96] Hayden, *The Great West*, 270-271.
[97] Hayden, *The Great West*, 172.

The beginning of this chapter on Nebraska contained a section on the state's geology that was then followed by a section on its climate. In Nebraska, according to Hayden, the Cretaceous and Tertiary deposits dominated and the land was the result of "the grinding of the mills of the gods which produced life and swept away life, ultimately resulting in the fertile Nebraska which is to-day."[98] Hayden surmised that this "marvelous story" was of interest to the farmer since the "richest soil in the world" was now "fixed in the condition which exists at this day" and was available for future agriculturalists.[99] The soil was virtually inexhaustible and worked like a "huge sponge" that absorbed moisture to later be used in times of drought. From "the growth and decay of innumerable centuries," Nebraska contained "a garden soil easily cultivated and making the arable farm as the garden."[100] Regarding the climate, Hayden emphasized, "[i]n the first place, there is water in abundance underground, on the surface, and coming from the clouds."[101] This "untilled garden-land," Hayden marveled, was once regarded as a desert.[102] Statistics on settlement spoke to the nonexistence of the desert. Simply put, "Men cannot make bread of sand, and so they do not settle in deserts."[103] Hayden believed that Nebraska was ideal for growing timber, for raising stock, and was "the best part" of the "great food-belt of the continent."[104] The success of these endeavors was heightened by the fact that the "railroad system of Nebraska permeates the State" and soon the entire state would be "penetrated by the iron way, the modern highway of

[98] Hayden, *The Great West*, 174.
[99] Hayden, *The Great West*, 174-175.
[100] Hayden, *The Great West*, 175.
[101] Hayden, *The Great West*, 175.
[102] Hayden, *The Great West*, 177.
[103] Hayden, *The Great West*, 179.
[104] Hayden, *The Great West*, 177, 179.

nations."[105] Settlers could use the pent-up products of geological ages for their benefit as the climate of the West was naturally enhanced and the fossil-fueled industrial railroads connected distant corners of the continent into a web of commerce.

Hayden's hope and firm belief in the changing climate of the West was shared by a number of his contemporaries from whom he likely derived his theories.[106] Cyrus Thomas was one prominent adherent, but there were two other individuals worthy of note who brought the mantra of rain follows the plow to the public. The man credited with this famous phrase is Charles Dana Wilber, Inspector of Mining Lands in the Western States and Territories, first secretary of the Illinois Natural History Society, and the superintendent of the department of geology and mineralogy at the Nebraska Academy of Sciences. His now infamous *The Great Valleys and Prairies of Nebraska and the Northwest* was published with the stated intention of encouraging agricultural settlement in the West and popularizing scientific knowledge.[107] One such piece of knowledge that formed the scientific core of this climatological theory came from a professor of natural science and geology named Samuel Aughey.[108] Wilber specifically thanked Aughey in

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[105] Hayden, *The Great West*, 186.

[106] Hayden likely received his knowledge about Nebraska from Samuel Aughey and Charles Dana Wilber.; Emmons, *Garden in the Grasslands*, 134.; Aughey had previously (1876) contributed to Hayden's *Eighth Annual Report* and had begun to advance his theories about the productive capacity of the soils released with cultivation.; Foster, *Strange Genius*, 183-184.

[107] Charles Dana Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest* (Omaha, NE: Daily Republican Print, 1881), iii-iv.

[108] Some of the initial writings of Aughey on this subject were not only in Hayden's surveys, but he also worked with Wilber to write in direct response to Powell's assertions about the arid West that will be discussed below. Like Hayden, Aughey and his popularizer Wilber lent considerable scientific authority to the theory.; Emmons, *Garden in the Grasslands*, 135-138, 185.; Hollon, *The Great American Desert Then and Now*, 145-146.; Kutzleb, "Can Forests Bring Rain to the Plains?," 18-19.; Smith, "Rain Follows the Plow," 111, 114, 116, 121, 126, 184-186.; Geographer Cary J. Mock described Aughey and Wilber as "two highly regarded scientists during the latter half of the nineteenth century."; Mock, "Rainfall in the Garden of the United States Great Plains," 173.: However, some of his contemporaries considered him a

his preface for his publication *Sketches of the Physical Geography and Geology of Nebraska* which he quoted from extensively in *The Great Valleys*.[109] In his publication, Aughey sought to "give an idea of the chain of events that resulted in the present order of things in Nebraska."[110] In what seems to be mutualistic relationships, with the help of Wilber and the regional railroads, Aughey concluded in his work that "rainfall is increasing from year to year."[111] More streams, changing vegetation, and "the spontaneous growth of timber" attested to the changing climate.[112] Using the geologic history of the West, Aughey dismissed the "secular" reasoning that saw the climactic changes simply as part of a larger cycle where "there are great periods when the moisture of a region increases for ages independent of any human agency, and that when it has reached a maximum it commences to decrease, which continues until it reaches a minimum."[113] The "objection" Aughey submitted was "that the geological causes which produce increased rainfall, are not now spontaneously operative."[114] The geography of the region was not the same as it was in the geologic past when the West was "dotted over with great fresh water lakes" and had "a much moister climate that the present."[115] Therefore, the same cycles of climate change could not be operating as they were during that pleasant past. Aughey claimed it was also not an "extraterrestrial" cosmic force, nor

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"charlatan."; Robert Manley, "Samuel Aughey: Nebraska's Scientific Promoter," *Journal of the West* 6 (January 1967): 117.

[109] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, iv-v.

[110] Samuel Aughey, *Sketches of the Physical Geography and Geology of Nebraska* (Omaha, NE: Daily Republican Book and Job Office, 1880), preface.

[111] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 41.

[112] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 41-42.

[113] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 43.; The very fact that this was the first theory addressed by Aughey, indicates that it was a commonly held theory concerning the return of climactic conditions that were viewed through the remains of geologic time.

[114] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 43.

[115] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 43.

the "iron on the railroad lines of the State and the wires of the telegraph lines" that increased rainfall.[116] The planting of trees in Nebraska served to assist the increase, but according to Aughey it "cannot be the main cause."[117] Aughey surmised that "[i]*t is the great increase in the absorptive power of the soil, wrought by cultivation, that has caused, and continues to cause an increasing rainfall in the State.*"[118] Once again, cultivated soil was understood as a sponge. Before it was broken up by agriculturalists, the soil was too compact as a result of ages upon ages of weather and the hooves of buffalo and other beasts beating it "as compact as a floor."[119] The western soil was like a concrete parking lot that does not absorb water but deflects it. As soon as the hardened soil had been broken, it opened up an avenue for moisture to remain.

Aughey assumed that some scientists would reject his claim on the grounds that "the whole Rocky Mountain region is in a comparatively rapid *process of drying up*." If Nebraska obtained a considerable amount of its water from the Rockies, this would definitely weaken Aughey's claim.[120] Aughey explained this position:

> One of the theoretical arguments presentedin [sic] proof of this view is, that in ages geologically recent, the Rocky Mountain area was a region of great lakes, and that it then lay at a much lower level, but that now the lakes have nearly all disappeared, and that it is still rising at the rate of

[116] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 43-44.
[117] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 44.; Other theories that circulated to explain the percieved change of climate in the West included the atmospheric effects of the railroad lines, effects generated by telegraph lines, and as was discussed previously, tree planting.; Davidson et al., "Gleanings from H-West: Rain Follows the Plow," 93.; Emmons, *Garden in the Grasslands*, 129.; Fleming, *Meteorology in America*, 3.; Kutzleb, "Can Forests Bring Rain to the Plains?," 16-17.; Webb, *The Great Plains*, 377-379.
[118] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 44.
[119] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 44-45.
[120] The theory of the drying up of the West was also held by Percival Lowell (discussed in relation to Mars in Chapter 8) for much the same reasons.

> a few feet to the century, and that, therefore, in the nature of things, the drying-up process must continue.[121]

This was false logic according to Aughey. He admitted that "[t]here have been many revolutions in the condition, geological and meteorological, of central and western North America in the mesozoic and cenozoic ages."[122] Aughey even conceded that "[t]he uplifting of the Rocky Mountains that commenced at the close of the cretaceous age, inaugurated the area of making of dry land which has continued to the present time, but with many intermissions."[123] Nevertheless, the facts observed by Aughey did not support this desiccation theory. Aughey condemned the theory as one of arm-chair geologists who did not visit the field as he had.[124] The drying up that had occurred up to that point was actually a blessing in that it created compact western soils.

What could explain these climactic shifts that could be observed in the geologic record? Aughey admitted that he would first call upon Charles Lyell, "that prince among naturalists."[125] Lyell had given geology the "fact that through the geological ages sea and land have many times changed places."[126] Yet, his theory was fatally flawed and Aughey believed the "cosmical theory" that was "proposed by and is still ably defended by James Croll, and is also maintained by James Geikie" was correct.[127] Essentially this "cosmical theory" of climate change could be boiled down to the orbit of the Earth and its distance from the Sun. Aughey deduced from this theory of climate change that "[a]ll the changes that may occur hereafter, therefore, for a long period will be favorable, and the globe as a

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[121] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 49.
[122] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 50.
[123] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 50.
[124] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 50.
[125] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 306.
[126] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 306.
[127] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 307.

whole become more and more fitted for a theatre for the development of mind and morals."[128] Ultimately, what Aughey's work illustrates is that the geologic history of the West was vital to how he and his contemporaries saw its past and potential future.[129] Boosting the West had as much to do with its deep past as its future potential.

The man who mattered when it came to Aughey's theories was Charles Dana Wilber. He worked wonders for popularizing the scientific notion of climate change advanced by Aughey.[130] Wilber saw in Kansas and Nebraska signs of "Divine Goodness" and problem solving of "the highest wisdom" in creating a natural landscape so well suited to cultivation.[131] The land's core topographical features, Wilber reckoned, were the product of former geological ages when water once covered the continent.[132] God and geology seemed to have shaped the West for agricultural civilization. Yet, the core of Wilber's contribution to boosting the West lay in his chapter on rainfall which drew

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[128] Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 308-309.; For more information on James Croll's theories, see: James Croll, *Climate and Time in their Geological Relations: A Theory of Secular Changes of the Earth's Climate* (New York: D. Appleton and Company, 1893).; James Roger Fleming, "James Croll in Context: The Encounter between Climate Dynamics and Geology in the Second Half of the Nineteenth Century," *History of Meteorology* 3 (2006): 43-53.; There is also another discussion ongoing at this time as regards climactic change. The return of an ice age was predicted by some scientists like Hayden. This made it into the press where earthquakes occurring in 1887 were correlated with a return to "another glacial age." However, another newspaper stated in 1887 that this would not occur for another thousand years.: *Little Falls Transcript*, April 08, 1887; "Science and Industry," *Ohio Democrat*, May 7, 1887.: For more information on the theories circulating regarding the return of an ice age, see: Archibald Geikie, *The Great Ice Age, and its Relation to the Antiquity of Man* (New York: D. Appleton and Company, 1874).; Christopher Hamlin, "James Geikie, James Croll, and the Eventful Ice Age," *Annals of Science* 39, no. 6 (1982/11/01 1982): 565-583.

[129] Aughey also commented on the Cretaceous coal resources of Nebraska. He noted that the prospects were slim, but that with abundant borings there could be coal located of a workable quantity. Aughey also referred to the Cretaceous Seaway as the "great American Mediterranean Sea," and noted that at the close of the Cretaceous, Nebraska was, "for the first time since the early Cretaceous," not entirely submerged underwater.: Aughey, *Sketches of the Physical Geography and Geology of Nebraska*, 206-209.

[130] In a section concerning the theory that "Rain Follows the Plow," Wilber quotes directly from Aughey's work described above: Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 72-78.; Smith, "Rain Follows the Plow," 185-189.; Emmons, *Garden in the Grasslands*, 139-141.; Kutzleb, "Can Forests Bring Rain to the Plains?," 19.; Kutzleb, "Rain Follows the Plow: The History of an Idea," 76, 122-126.

[131] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 14.

[132] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 23.

heavily on Aughey. He began this chapter by asserting that it was "generally accepted as a fact that the area of increased precipitation is gradually extending toward the Rocky Mountains."[133] Wilber also rewrote the history of the Louisiana Purchase in light of the reports of Zebulon Pike and Stephen Harriman Long to show that its purpose was to provide a frontier barrier and a defensive bulwark. It was not, according to Wilber, for the purpose of extending the agricultural empire of the United States. But the "steady westward march of the 'Star of Empire' from the Atlantic toward the center of our National area" could not be stopped and had forced a revision of that previous vision.[134] It was time, Wilber decreed, that "our manifest destiny" be realized through the use of the "material resources of the West."[135]

In this chapter, with the help of many graphs, charts, and expert opinions, Wilber pushed forward the theory that rain follows the plow [Figure 51].

> Suppose now that a new army of frontier farmers – as many as could occupy another belt of 50 miles, in width, from Manitoba to Texas, could, acting in concert, turn over the prairie sod, and after deep plowing and receiving the rain and moisture, present a new surface of green, growing crops instead of the dry, hard-baked earth covered with sparse buffalo grass. No one can question or doubt the inevitable effect of this cool condensing surface upon the moisture in the atmosphere as it moves over by the Western winds. A reduction of temperature must at once occur, accompanied by the usual phenomena of showers. The chief agency in this transformation is agriculture. To be more concise. *Rain follows the plow*.[136]

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[133] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 49.
[134] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 49-50.
[135] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 50.
[136] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 68.

The only reason there should be a desert anywhere, Wilber remarked, was simply the product of "man's permission or neglect." Man must be "aggressive" in overturning the deserts of the world.[137] Human agency was all that was needed to make the West a garden. No "magic or enchantment, nor…incantations or offerings" would achieve this garden goal. It was by the "sweat of his face, toiling with his hands" that "man can persuade the heavens to yield their treasures of dew and rain upon the land he has chosen for a dwelling place."[138] Using scripture as his source, Wilber reasoned that the "first condition of the earth was largely desert."[139] Yet, "the Creator never imposed a perpetual desert upon the earth, but, on the contrary, has so endowed it to man, by the plow, can transform it, in any country, into farm areas…and to make even a desert blossom as a garden with roses."[140] Searching through geologic history in a subsequent chapter looking for the origins of the prairies, Wilber also concluded that "both prairie and forest are natural conditions, and that it is in the power of man to make or unmake, to have either surface, or to combine the two in any manner suited to his use or caprice" [Figure 52].[141]

Wilber's West was made through human agency that was empowered by geology. How could humans have such power, or believe that they have such power to match the might of natural forces? The answer came from the depths of the earth. Coal. It is not

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[137] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 69.
[138] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 70.
[139] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 70.
[140] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 71. Wilber also quotes extensively from a Mr. Holton who expresses similar sentiments and also references the effects of electricity in the air and the role of the railroads and telegraph (Holton is actually Hugh R. Hilton of Topeka, KS). There is also reference by Wilber to the idea that Native Americans were poor husbands of the land and that their practices made the region into a desert.; Kutzleb, "Rain Follows the Plow: The History of an Idea," 123.; Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 70.
[141] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 119.

surprising that the resource that "still engages public attention more than any other topic relating to our natural resources" according to Wilber, was the "supply of coal within the limits of Nebraska."[142] The Cretaceous coal deposits were the most abundant in Nebraska and were especially significant because of coal's value as a powerful fuel to "heat without cost" and perform "the general drudgery of mankind."[143] "It is found in nature, ready made," according to Wilber, and "King Coal" made it possible to harness the "all-potent energy of steam to form and fashion, spin and weave, dig down mountains, fill up valleys, cook our food, do the washing, carry us abroad around the world and bring us safe home again; in short, do anything, except voting."[144] The West's settlement and transportation networks were built on this resource. "The railroad kings want to know" where coal can be found in the United States "because coal deposits determine the direction of the railways."[145]

Geology's economic importance and visibility as a science granted it a privileged position in booster literature. It was authoritative and could be used to support claims about the future of the land. The geology of the soils was not necessarily directly relevant to the prospective settler. The explanation of their origins and composition was simply a method to provide scientific backing to booster claims. Geology was important for boosters insofar that it painted a malleable environment and granted scientific backing to what could easily be dismissed as interested and specious claims by moneyed men.

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[142] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 175.
[143] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 177.
[144] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 177.
[145] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 179.

Settlers and potential emigrants were subjected to an advertising blitz that came at them from scientists, newspapers, land speculators, boosters, railroads, and even state and Federal Government agencies.[146] The amount of information that was produced advancing the idea of a positive climactic change in the West could have only generated and distributed *en masse* in a fossil-fueled industrial society such as America. Scientific authority and technological optimism was also built upon these energetic resources. These forces conspired to make the changing climate of the West a viable possibility to many who sought escape from increasingly crowded cities or simply sought to make a new life in the future garden of America.

William Babcock Hazen Vs. the Northern Pacific Railroad: Confronting Booster Visions of a Garden West

The railroads made it possible to explore previously unexplored regions to find evidence of a malleable West, and made it profitable to speak of these regions in a positive light. The Great American Desert retreated before the tracks of the transcontinentals until it was no more. Much of the booster literature that came out of the transcontinental lines was used to destroy the idea of the desert.[147] As soon as the theory that rain followed the plow gained popular appeal, the railroads embraced it and encouraged its perpetuation in order to crush all that remained of the desert-West.[148]

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[146] Kutzleb, "Can Forests Bring Rain to the Plains?," 16, 18.; Kutzleb,"Rain Follows the Plow: The History of an Idea," 52, 65-68, 90, 94-98, 140-144, 195-196.; According to Kutzleb, given all of this information, "[i]t was easy for immigrants to conclude that Divinely sanctioned settlement could not fail.": (Kutzleb,"Rain Follows the Plow: The History of an Idea," 68.)

[147] Emmons, *Garden in the Grasslands*, 129.

[148] Emmons, *Garden in the Grasslands*, 141; Hollon, *The Great American Desert Then and Now*, 143-144.;Allen, "The Garden-Desert Continuum," 214.; Robert G. Athearn, "The Great Plains in Historical Perspective," *Montana: The Magazine of Western History* 8, no. 1 (1958): 22-25; Richard White,

Theories of progressive climactic change were vital to the project of overturning the Great American Desert and making a profitable garden-West.

Railroads such as the Northern Pacific boosted for the land along their lines and promised a region blessed with beautiful scenery, a healthful climate, fertile agricultural soils, and abundant resources.[149] Interestingly enough, as the desert was disappearing from maps as the railroads entered into the West, it made a resurgence in the minds of settlers who encountered the aridity of the West first hand. The land, while capable of sustaining agriculture in certain western locales, was not the Edenic garden depicted in publications put out by boosters and the western railroads. With the discovery of hard truths about agriculture in the West, many settlers and commentators began to consider if the West really was all that the boosters and the railroads had revealed it to be. Through the work of General William Babcock Hazen, this section will demonstrate that opposition existed that questioned the wisdom of the boosters. Furthermore, it will show that he never rejected the productive capacity of western soils, and why it is crucial to recognize that geology was decidedly absent from Hazen's rejection of climactic change.

Like the railroads, as Richard White claimed, the agricultural frontier was forced, subsidized, and advanced too rapidly.[150] The two processes cannot be disassociated. This led to massive failures, both ecological and economic, and forced adaptations to the hard realities of the potential for farming in arid and semi-arid areas. Drought dehydrated the

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Railroaded: The Transcontinentals and the Making of Modern America (New York: W.W. Norton & Co., 2011), 486-493.

[149] Advertisements and pamphlets abounded for the lands traversed by the transcontinental railroads. For an example of the boosting literature published by the railroads, see: Jay Cooke, "The Northern Pacific Railroad; Its Route, Resources, Progress and Business. The New Northwest and Its Great Thoroughfare," (Jay Cooke & Co., 1871).; W. C. Riley, *The Official Northern Pacific Railroad Guide, for the Use of Tourists and Travelers over the Lines of the Northern Pacific Railroad* (St. Paul, MN: W.C. Riley, 1891).

[150] Richard White, *Railroaded*.

watery wishes of western settlers and boosters. Climate change theories became sand and desiccated soil falling through the hands of helpless farmers. Some saw the struggle of settlers in the West and sought to remedy it through reckoning with the arid nature of the West.

Even for those associated with the railroads and likely attuned to their rhetoric, failure was easy to spot. A man on a reconnaissance project for the Great Northern Railroad observed, in 1889, the failure encountered by farmers on the western North Dakota and eastern Montana frontier. He traveled through what he described as "the most dreary and monotonous…desolate prairie country" where the land "seemed utterly forsaken and the villages nearly as much so." The terrible condition of this area was the product of "a failure of crops for two years."[151] Furthermore, Greeley's supposed advice to "Go West" was also coming under attack. One young man, as reported in 1874, took Greeley's advice and headed West only to find thieves, card cheats, and almost was run over by a train.[152] Another article from 1876, plainly stated, "Horace Greeley's advice to 'Go West' was a glaring swindle. The fact that the Indians have been living West all their lives and are still poor, with scarcely enough clothes to hide their nudity, proves this."[153] The sanguine words of boosters and advocates of western migration and settlement began to seem like bloody lies to many migrants who heeded their call and embraced their advertisements.

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[151] Charles Frederick Beals Haskell, "On Reconnaissance for the Great Northern; Letters of C.F.B Haskell, 1889-1891," New York Public Library, 1948. PAM 103. Montana Historical Society Research Center.
[152] "Going West. The Checkered Experiences of a Young Man Who Took Horace Greeley's Advice," *San Francisco Chronicle*, February 28, 1874; For another example of a similar statement about a man's experience in Montana, see: "Told by the Sufferer," *The River Press*, January 19, 1887.
[153] *Spirit of Jefferson*, February 29, 1876.

General William Babcock Hazen, who, in 1880, would become the chief signal officer for the War Department in charge of scientists and other amateur observers of weather in the West, had some choice words to say about the climactic nature of the region in 1875.[154] In the *North American Review*, Hazen explained that Americans should consider the region somewhere in between a garden and a "valueless waste."[155] The West beyond the 100th meridian, however, was a land of extremes. "Nothing can surpass the fruitfulness and beauty of this section in seasons of plenty, – which has given rise to much beautiful but partial description," Hazen observed, " – nor its desolation in drought."[156] Irrigation was a necessary practice for any successful agricultural endeavor. For example, "[a]t military posts," Hazen reported, "gardens have, only by irrigation, been made possible."[157] Hazen, who consistently considered himself correct and infallible, firmly rejected the hopes of naturally improving western climates.[158] "The very popular theory that the rainfall is increasing in that country, and that it is due to the effects of civilization," Hazen stated, "is not supported by accurate measurements. The

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[154] Edward S. Cooper, *William Babcock Hazen: The Best Hated Man* (Madison, NJ: Fairleigh Dickinson University Press, 2005), 277-290.; Emmons, *Garden in the Grasslands*, 163-164.; Carolyn Thomas Foreman, "General William Babcock Hazen," *Chronicles of Oklahoma* 20, no. 4 (1942): 338.; Mock, "Rainfall in the Garden of the United States Great Plains," 179.; Later, Charles Dana Wilber would charge it was an unnatural fascination with desert environments that led Hazen to his attention to aridity. Wilber used Hazen as an example and explained, "I have selected from Gen. Hazen's article in the North American Review, 1878, a few extracts, as best representing the American desert literature, for which there seems to be a demand or craving, especially in eastern circles, for a reason similar to that which calls for stimulants, and which is proof of a vitiated taste instead of a healthy condition."; Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 138.; It is interesting that Martyn J. Bowden made a similar charge about the popularity of the Great American Desert in eastern regions: Martyn J. Bowden, "The Great American Desert and the American Frontier, 1800-1882: Popular Images of the Plains," in Tamara K. Hareven, *Anonymous Americans; Explorations in Nineteenth-Century Social History* (Englewood Cliffs, NJ: Prentice-Hall, 1971), 58, 68.

[155] General W. B. Hazen, "The Great Middle Region of the United States, and Its Limited Space of Arable Land," *North American Review* CCXLVI (January, 1875): 1.

[156] Hazen, "The Great Middle Region of the United States, and Its Limited Space of Arable Land," 2.

[157] Hazen, "The Great Middle Region of the United States, and Its Limited Space of Arable Land," 7.

[158] Cooper, *William Babcock Hazen*, 241.

natural laws that govern these phenomena are too broad and general to be affected by the slight results of civilization already found there. The wish is the father to the thought."[159] Notably, however, Hazen believed what many irrigation advocates claimed, "[t]here is no fault of soil anywhere. The fault is in the want of water."[160] On the basis that the West lacked adequate rainfall, he refuted the old Jeffersonian dream of the yeoman farmer and the agricultural republic. "And the old song of 'Uncle Sam is rich enough to give us all a farm' will no longer be true," Hazen warned, "unless we take farms incapable of cultivation."[161] Hazen resisted the hopeful vision of those who wished to make a garden out of the West by simply settling it, but he did not undermine the faith in the productive

[159] Hazen, "The Great Middle Region of the United States, and Its Limited Space of Arable Land," 17.
[160] Hazen, "The Great Middle Region of the United States, and Its Limited Space of Arable Land," 22.; An interesting side note that may have had bearing on his thoughts on limiting western settlement was his sentiments about Native American land. Hazen had served for a time as a superintendent of Indian Affairs and he stated, "[t]he lands of the Indian Territory are owned by the Indians themselves, not as a reservation set aside for their use, but as compensation for their having surrendered valuable considerations, in farms and other lands, to the United States, and they hold patents for them from the Land Office. If there is any one pledge of the government more sacred than another, it is that these people may have a perpetual home there."; (Hazen, "The Great Middle Region of the United States, and Its Limited Space of Arable Land," 23).; He also sought to educate Native Americans in the benefits of obtaining titles for their land through the United States in order to secure their right to the land.; (Foreman, "General William Babcock Hazen," 334, 336-337).; However, Hazen was a complicated man and even though he reserved some positive sentiments or regret for Native Americans, he firmly believed that good Native Americans were a thing of the past only to be found in literature such as Cooper's novels. What had to be done was civilize the Native Americans that still existed and aggressively punish those who did not submit to the will of the United States.; (Cooper, *William Babcock Hazen*, 164-165, 206).
[161] Hazen, "The Great Middle Region of the United States, and Its Limited Space of Arable Land," 23.; Hazen was referring to the 1850 song "Uncle Sam's Farm" by Jesse Hutchinson Jr. The chorus of the song: "Come along, come along, make no delay, Come from every nation, come from every way, Our land is broad enough – don't be alarmed, For Uncle Sam is rich enough to give us all a farm."; ("Uncle Sam's Farm," Duke University Libraries, Digital Collections, accessed July 8, 2014, http://library.duke.edu/digitalcollections/songsheets_bsvg200915/#info.) ("Uncle Sam's Farm," Microfilm M 3106 M1.A12V vol. 36 Case Class, Library of Congress. Accessed Jul 8, 2014., http://www.loc.gov/item/sm1850.470050.); The song was used in booster literature for the West. The lyric "Uncle Sam is Rich Enough to Give us All a Farm" graced the top of an 1871 booster broadside for "The Free Lands of Dakota."; "Uncle Sam is rich enough to give us all a farm. Homes in the West! The free lands of Dakota! The territory of Dakota contains the most desirable government lands for the purpose of agriculture in all its branches that are now open to settlement,": "Homes in the West," Stone & Kingsbury, Yankton, 1871. Portfolio 13, Folder 2a. Broadsides, leaflets, and pamphlets from America and Europe. Library of Congress, accessed July 8, 2014, http://hdl.loc.gov/loc.rbc/rbpe.0130020a.)

capacity of the soils that would later capture the minds of men who used the power of industrial society to irrigate and use science to take advantage of these rich soils.[162]

Hazen was particularly angry about the Northern Pacific Railroad's dishonest efforts to boost the West along their line.[163] As discussed above, he published his first thoughts on this subject in the *North American Review* in 1875. Hazen subsequently followed up with *Our Barren Lands* that same year in order to answer his critics. Hazen defined the West as the region west of the 100th meridian bordered on the west by the Sierra Nevada Mountains, Canada (British America at that time) to the north, and Mexico as the southern border.[164] When the early argonauts sought glittering treasure in the West, according to Hazen, they left in their wake a "ghastly spectacle of bleaching bones of men and animals" along the "perilous passage" across the Great American Desert.[165] Hazen hated the deception of the Northern Pacific Railroad because:

> Railroads were exploited in many directions across the border. Some of these were justified by commerce – more were cheating schemes for the purpose of getting subsidies of land from the United States. Once in possession of this land, every effort, honest and dishonest, was made to induce persons to purchase it and settle upon it. And so, suddenly, by means of that magic power, the Press, those "bad lands," "sandy plains," "wasted deserts," "el llano estado," "basins of salt," "black hills," and so on, became

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[162] These attempts will be discussed in the next chapter.
[163] Smith, "Rain Follows the Plow," 171, 180.; Kutzleb, "Rain Follows the Plow: The History of an Idea," 72-75.; Hazen, "The Great Middle Region of the United States, and Its Limited Space of Arable Land," 24-34.; Cooper, *William Babcock Hazen*, 238-243.; For information Hazen's life and military career, see: Foreman, "General William Babcock Hazen," 322-342.; Cooper, *William Babcock Hazen*.; For an examination of how the Northern Pacific boosted the West, see: Sig Mickelson, *The Northern Pacific Railroad and the Selling of the West: A Nineteenth-Century Public Relations Venture*, Prairie Plains Series (Sioux Falls, SD: Center for Western Studies, 1993).
[164] William Babcock Hazen, *Our Barren Lands. The Interior of the United States West of the One-Hundredth Meridian and East of the Sierra Nevadas* (Cincinnati, OH: Robert Clarke & Company, Printers, 1875), 5.
[165] Hazen, *Our Barren Lands*, 5.

> fruitful as the vale of Cashmere. Here were "homes" for the "homeless" and "lands for the landless." These and other catchwords were used to ensnare the unwary.
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> The efforts which were and are made to sell lands thus acquired, are familiar to the public. The fruitless, exhaustive struggle of the settler to produce something from the barren soil, his misery and destitution, only those can know whose duties station them within the confines of those worthless lands, and where they have opportunities for personal observation.[166]

After serving six years as a soldier along the line of the Northern Pacific Railroad, Hazen concluded that the lands around the tracks were useless for agriculture and that it was possible to extend this conclusion to the entirety of the West.[167] Hazen explained that "facts" gathered in the West by individuals such as Lorin Blodgett and institutions such as the Surgeon General of the Army had "incontrovertibly proven" that the lands of the West were useless because of an "insufficient fall of rain" that was constant and unchanging in the face of settlement.[168] The Northern Pacific Railroad had even

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[166] Hazen, *Our Barren Lands*, 6.

[167] Hazen, *Our Barren Lands*, 7, 33, 41.

[168] Hazen, *Our Barren Lands*, 6-9, 35.; Hazen, "The Great Middle Region of the United States, and Its Limited Space of Arable Land," 3, 16-17, 21.; Blodget's career as a scientist concerned with meteorology was in part due to his role as an observer for the Smithsonian meteorological project. However, the data collection he perfomed for the Smithsonian became a point of contention in what James Fleming called "The Blodget Affair." He had worked as a clerk for the Smithsonian and left after percieved slights and relations between Joseph Henry and Blodget soured substantially. Blodget worked hard to undermine Henry and to take the helm of American meterology, but he ultimately failed. Nonetheless, he was successful in publishing his important work *Climatology of the United States* in 1857 using data he "pilfered" from the Smithsonian. In this book, he refered to as the "Arid and Interior Areas" where "arid climates as a class are new to us, and their peculiarities are not readily understood." Though Blodget was confident that climatic conditions were permanent. He stated, "[i]f the sun's heat is a constant quantity therefore, all the changes we observe are periodic as belonging to the day and year, and non-periodic in all other cases – the averages always returning to a line of the most absolute permanence." Blodget nonetheless had to address the changes wrought through geologic time. He stated, "[t]he surface of the earth and its geological structure have at some remote interval undergone great changes, but there are none now in progress which are sufficiently important to influence the climate in any degree. Whether the relations of mass were always the same as now between the land and sea we are unable to say; changes of these would greatly affect the distribution of heat, whether the measure for the whole earth underwent any change or not. But it is certain that no changes of subsistence, elevation, or contininetal outlines, have occurred within any period which might give reason to believe that such changes belonged to the present

manipulated Blodgett's data in order to make their lands seem scientifically suited for settlement.[169] Hazen, however, admitted that there had been a period of "anomalous" wet weather during 1872 and 1873 that had "misled hopeful people" and "encouraged settlements" that were "now being abandoned all along the line."[170] He sought to tell "the true character of the country" and stem the "tide of immigration" that was washing over the West.[171] Boosters artfully created "puerile inventions" that were "supported by the name of the national government" to fool "the poor, the lowly, the widow, and the orphan" into wasting their time and money on a hopeless venture.[172] Hazen had had it with these hucksters.

One of Hazen's most poignant examples of farm failure was at Fort Berthold, Dakota Territory. A letter written to Hazen explained the conditions that all attempts at agriculture confronted in this country. This "most worthy gentleman" believed that "farming in Dakota is a total impossibility" and that "[i]t is a monstrous fraud and a great wrong for interested parties to induce immigration to this territory."[173] Those who were already there, such as the "Rhee Indians" had no choice but to participate in this failed venture. The agency farm at Fort Berthold was "a dead failure" and "swallowed up the

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order of things; - it is certain that none are now in progress." And he dismissed the idea that "any artificial agencies may permanently modify our own climate."; Lorin Blodget, *Climatology of the United States: And of the Temperate Latitudes of the North American Continent, Embracing a Full Comparison of These with the Climatology of the Temperate Latitudes of Europe and Asia, and Especially in Regard to Agriculture, Sanitary Investigations, and Engineering, with Isothermal and Rain Charts for Each Season, the Extreme Months, and the Year* (Philadelphia, PA: J. B. Lippincott and Co., 1857), 165-192, 481-482.; Fleming, *Meteorology in America*, 76, 110-115.; Kutzleb, "Rain Follows the Plow: The History of an Idea," 21, 29-30.

[169] Hazen, *Our Barren Lands*, 46-47.
[170] Hazen, *Our Barren Lands*, 16, 48-49.
[171] Hazen, *Our Barren Lands*, 46, 52.
[172] Hazen, *Our Barren Lands*, 51.
[173] Hazen, *Our Barren Lands*, 23-24.

chief part of the appropriation" to the Native Americans in this region.[174] The civilizing potential of agriculture could not take effect in such a region and as an imposed measure upon the Native Americans it amounted to a crime against these peoples who were not duped by the railroads but rather relegated to an impossible existence by the deluded hopes of the government.

In confronting the powerful onslaught of the boosters and public opinion about the future of the nation, Hazen faced formidable foes. He marched confidently forward into the morass that was the debate over the desert-West. Hazen's firm convictions and unwavering dedication to what he perceived as the truth earned him the title "the best hated man" by one of his topographical engineers.[175] In regards to the West, he was "accused of hostility to a great interest, ignorance of the subject, and bribery."[176] The most vociferous adversary was a famous fellow officer, General George Armstrong Custer. Hazen's *Our Barren Lands* was centered on Custer's critique. Hazen had thought that, like many settlers seeking the garden-West, General Custer was hoodwinked by the temporary wet period that passed through the plains in the early 1870s.[177] Custer regarded the Northern Pacific Railroad line as well-watered prime agricultural land and believed that Hazen had impure motives in maligning the West.[178] His Black Hills Expedition was considered by many as "the 'Custer gold-hunting expedition'" and it was

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[174] Hazen, *Our Barren Lands*, 24-25.
[175] Cooper, *William Babcock Hazen*, 315-316.
[176] Hazen, *Our Barren Lands*, 7.
[177] Hazen, *Our Barren Lands*, 10.
[178] Hazen, *Our Barren Lands*, 11-12.; The Northern Pacific's line was even termed the "banana belt" by boosters. For example, in 1882, a *Bismarck Tribune* article stated, "Jay Cook's banana belt has been ridiculed for years, but in these figures is found proof that the chenook or warm west winds, must naturally follow the lower track through which the North Pacific passes."; C.A.L., "Superiority of the North Pacific," *Bismarck Tribune*, October 6, 1881.

during this trip into the West where he formed his positive opinion.[179] Hazen did not entirely fault Custer for his views since he understood that one must consider "their stand-point of observation in order to properly interpret their writings."[180] The newspaper men who saw the lands as barren were seeing the lands as they were, while Custer was seeing the land through the lens of his military training and the limited needs of troop movement through the West.[181] Hazen quoted from a New York *Tribune* correspondent who went through the same country as Custer and found a country good for grazing, but deficient in rain and poor in soils. The reporter concluded, "[t]he sad necessity of redeeming it has not yet arrived."[182] While he stated that "[i]t is useless to deny that the country is a desert," the correspondent was realistic in realizing that the West would inevitably be settled and that it could be redeemed from its poor condition.

In his writings, Hazen hints at no such potential for the western region. The land was not malleable in his estimation, and significantly he did not muster the science of geology to support his stance. Geology showed change on the western plains, while Hazen perceived the lack of precipitation and the desert condition of the West as permanent.[183] The soils, which Hayden, Aughey, and Wilber would later extoll as bountiful beyond compare, were understood by Hazen to have the capacity to support agriculture. It was the climate that mattered, and without a geological framework in mind

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[179] Hazen, *Our Barren Lands*, 27-31.
[180] Hazen, *Our Barren Lands*, 30.
[181] Hazen, *Our Barren Lands*, 30, 42-43.
[182] Hazen, *Our Barren Lands*, 18-20.
[183] Hazen's biographer Edward S. Cooper suggested that Hazen's perception of the West lacked foresight into the technological advances that would bring water to the West. However, Cooper also noted that in 2002 a North Dakota Humanities Council member stated that Hazen was actually correct about the potential for agriculture along the Northern Pacific Railroad line. Water was lacking and irrigation was not an adequate solution.; Cooper, *William Babcock Hazen*, 240, 243.

it was static.[184] Hazen represented the contingent of Americans who did not believe in the western garden. However, because he did not refute the productive capacity of the West's soils, Hazen's vision did not counter the science that lay beneath the irrigation crusade that would come later. He also did not attempt to address the changes that had formed the basis for many climate change theories and so evidently taken place in the West throughout its history. Like Powell below, his assessment of the Great American Desert was undermined by geology.

John Wesley Powell's *Arid Lands*: Geology's Role in its Internal Contradictions and External Pressures

Hazen was not the only voice in the desert-West declaring its dismal future.[185] John Wesley Powell's *Report on the Lands of the Arid Region of the United States* serves as *the* government document of the late nineteenth century that defined a different vision of the West. Powell outlined a plan that would alter government land policy and the future of western settlement.[186] Many historians have noted his foresight but eventual

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[184] Hazen's inattention to geology could have perhaps been rooted in the fact that in his study of mineralogy and geology he placed 21st out of 35 cadets.: Cooper, *William Babcock Hazen*, 26.

[185] A number of historians have also since noted that aridity and environmental limits characterize the West. This has often lead to celebratory rhetoric regarding those who shared in recognizing that the West was a land of limits rather than abundance.; Norris Hundley Jr. "Water and the West in Historical Imagination," *The Western Historical Quarterly* 27, no. 1 (1996): 5-31.; Carl Frederick Kraenzel, *The Great Plains in Transition* (Norman, OK: University of Oklahoma Press, 1955).; Marc Reisner, *Cadillac Desert: The American West and Its Disappearing Water* (New York: Penguin Books, 1993).; Walter Prescott Webb, "The American West: Perpetual Mirage," *Harper's Magazine*, 1957, 25-31.; Wallace Stegner, *The American West as Living Space* (Ann Arbor, MI: University of Michigan Press, 1987).; Walter Prescott Webb, "The West and the Desert," *Montana: The Magazine of Western History* 8, no. 1 (1958): 2-12.; Worster, Donald. *Rivers of Empire: Water, Aridity, and the Growth of the American West* (New York: Pantheon Books, 1987).

[186] Smith, "Rain Follows the Plow," 181-184.; Two great biographies of Powell are: Stegner, *Beyond the Hundredth Meridian*; Donald Worster, *A River Running West: The Life of John Wesley Powell* (New York: Oxford University Press, 2001).

failure in the face of optimistic resistance to his vision of environmental limits.[187] That Powell was undercut by the West's geology has not been acknowledged. Powell's vision relied on a West of perpetual limits. As discussed above, the geologic history of the West inspired hope in an ever-changing environment. In the case of Powell's report, his geologist Grove Karl Gilbert could not justifiably reject the West's plasticity. Also, Powell became embroiled in a public and political dispute that was connected with the "Bone Wars" and the future of the USGS. This served to damage his reputation and make it easier for Americans to snub his plans and adhere to philosophies of western abundance.

The U. S. Government was a partner in imagining and pushing the garden-West onto the American public and enabling this rapid settlement. This was done through the Homestead Act and the granting of enormous tracts of land to the transcontinental railroads.[188] The Homestead Act was built upon the Jeffersonian dream of an agricultural republic in America's garden.[189] It granted citizens 160 acres to prove up and pay only $10 for the title.[190] The government and many hopeful citizens did not abandon this

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[187] For example, see: Reisner, *Cadillac Desert*, 45-51.; Wallace Stegner, "Editor's Introduction," in John Wesley Powell and Wallace Stegner, *The Arid Lands* (Lincoln, NE: University of Nebraska Press, 2004), xiii-xxxi.; Stegner, *Beyond the Hundredth Meridian*, vii-viii, xvi.: His biographer, Donald Worster, notes his celebrity as well.: Worster, *A River Running West*, xi-xii.

[188] For information on railroad land grants, see: Ross Ralph Cotroneo, *The History of the Northern Pacific Land Grant, 1900-1952* (New York: Arno Press, 1979).; Robert V. Hine and John Mack Faragher, *The American West: A New Interpretive History* (New Haven, CT: Yale University Press, 2000), 281-282.; Albro Martin, *Railroads Triumphant: The Growth, Rejection, and Rebirth of a Vital American Force* (New York: Oxford University Press, 1992), 170-174.; Lloyd J Mercer, *Railroads and Land Grant Policy: A Study in Government Intervention* (Washington, DC: Beard Books Incorporated, 2002).; John B Rae, "The Great Northern's Land Grant," *The Journal of Economic History* 12, no. 2 (1952): 140.; White, *Railroaded*, 23-38, 59-62, 456-459.; Richard White, *"It's Your Misfortune and None of My Own": A New History of the American West* (Norman, OK: University of Oklahoma Press, 1991), 246-258.

[189] Hine and Faragher, *The American West*, 109.

[190] Hine and Faragher, *The American West*, 333-336.; White, *"It's Your Misfortune and None of My Own"*, 140-145.

dream when the arid frontier forcefully confronted settlers that failed miserably in an environment that did not live up to its fertile tales. Rather, the Homestead Act was repeatedly amended in attempt to save a dying dream. Two significant amendments that provided the life support for this dream were the Timber Culture Act of 1873, and the Desert Land Act of 1877. The Timber Culture Act required a settler to plant 40 acres of trees on their quarter section for ten years. As discussed previously, this fit into the theory of climactic change in the West whereby trees would bring rains that would benefit agriculture and make the region a garden.[191] Four years later it was clear that another Act must be passed to deal with what were becoming stark realities concerning life in the West. Certain areas, it was admitted in the Desert Land Act of 1877, were arid and required larger plots to successfully farm. The Act allowed for homesteads of 640 acres that had to be irrigated within three years. Again, this Act failed to reconcile itself with the realities of the West where it was virtually impossible to irrigate that large of a plot as an individual.[192]

John Wesley Powell recognized that these amendments were insufficient and not in tune with the arid nature of the West. In his *Report*, he expressed his specific concerns with the area that he defined as the "Arid Region." It began "about midway in the Great Plains" and containing "the great Rocky Mountain Region of the United States, and it

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[191] Hollon, *The Great American Desert Then and Now*, 144.; Kutzleb, "Can Forests Bring Rain to the Plains?"; Emmons, "Theories of Increased Rainfall and the Timber Culture Act of 1873,".; C. Barron McIntosh, "Use and Abuse of the Timber Culture Act," *Annals of the Association of American Geographers* 65, no. 3 (1975): 347-362.

[192] White, *"It's Your Misfortune and None of My Own"*, 150-152.; David E. Nye, *America as Second Creation: Technology and Narratives of New Beginnings* (Cambridge, MA: MIT Press, 2003), 211.; Stegner, "Editor's Introduction," in Powell and Stegner, *The Arid Lands*, xvi.

embraces something more than four-tenths of the whole country, excluding Alaska."[193] Using precipitation data from the Smithsonian and from Charles Anthony Schott, Powell pronounced that "[t]hese lands will maintain but a scanty population."[194] With only a "small portion" of the Arid Region irrigable, Powell made one of his most scandalous statements regarding the use of the majority of the lands in "pasturage farms."[195] Instead of the traditional 160 acre plot allotted in the 1862 Homestead Act, Powell saw the best prospects for the West in pasturage farms of "at least 2,560 acres."[196] These pasture lands would not be fenced and they should "conform to the topography" rather than consist of the long-standing rectangular survey sections.[197] On the basis of the West's aridity, Powell's recommendations would have amounted to a complete revision of the land system adopted by the Federal Government.[198]

The changes that Powell contemplated and conveyed to Congress were only applicable if the West's climate was static and the land of the West was irredeemable from its barren state. However, the *Report* did not definitively state that the West was interminably arid. For example, the geologist Grove Karl Gilbert wrote a section titled "Water Supply" that studied the rising water levels in the Great Salt Lake drainage-

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[193] Powell and Stegner, *The Arid Lands*, 11, 15.
[194] Powell and Stegner, *The Arid Lands*, 9, 33, 58.; James Fleming had noted that Schott's rigorous statistical methods "were more reliable than those of Blodget. They were undoubtedly used to shape government land policy for the arid West." Schott also "argued against the notion of a changing climate."; Fleming, *Meteorology in America*, 129.; Fleming, *Historical Perspectives on Climate Change*, 51.
[195] Powell and Stegner, *The Arid Lands*, 16, 30.
[196] Powell and Stegner, *The Arid Lands*, 32, 40-41.
[197] Powell and Stegner, *The Arid Lands*, 33.
[198] It is important to note that Powell was likely inspired by the nature of Mormon practices for water stewardship and land use.: Worster, *A River Running West*, 353-354.: See also the report by Captain C. E. Dutton titled "Irrigable Lands of the Valley of the Sevier River," in the *Arid Lands Report.*; Powell and Stegner, *The Arid Lands*, 142-143.

basin.[199] As a geologist, Gilbert could not deny the geologic history of the region and interjected elements of a malleable West into the Powell's death-defying dismissal of the garden dream. One theory that he proposed was that the climate was changing and thereby increasing the amount of precipitation in the region. "By some it is thought," Gilbert stated, "that the climate of the district is undergoing, or has undergone, a permanent change."[200] He had originally believed that the climate was simply oscillating, but thought that another hypothesis was "far more probable."[201] Gilbert used his geological training to situate the climactic change within the framework of the malleable world revealed through geologic history. The climate change that this western region was experiencing could have been "one of those gradual climactic changes, of which geology has shown the magnitude and meteorology has illustrated the slowness, here finds a manifestation."[202] Geologically speaking, Gilbert considered that this change may be abrupt but that there was not enough data available to say either way. Using the available climactic information, Gilbert surmised that the increase in rainfall was "not of incredible magnitude, and consequently that the hypothesis which ascribes the rise of the lake to a change in the climate should be regarded as tenable."[203] However, he avoided "referring the change to any local cause" because the "weather of the globe is a complex whole."[204]

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[199] For a biography of Grove Karl Gilbert, see: Stephen J. Pyne, *Grove Karl Gilbert: A Great Engine of Research* (Iowa City, IA: University of Iowa Press, 2007).
[200] Powell and Stegner, *The Arid Lands*, 81.
[201] Powell and Stegner, *The Arid Lands*, 82.
[202] Powell and Stegner, *The Arid Lands*, 82.
[203] Powell and Stegner, *The Arid Lands*, 84.
[204] Powell and Stegner, *The Arid Lands*, 84.

Gilbert was apprehensive about the ideas that ascribed the change to "cultivated lands," "prayers," "telegraph wires," or "iron rails."[205] The "agency of man," Gilbert stated, was nonetheless a possible cause as it was "advocated by Professor Powell."[206] While he asserted that Cyrus Thomas' claims were "reached…by a leap," Gilbert did entertain the idea of human agency effecting climate.[207] His summative remarks leave plenty of room for hopeful skepticism.

> On the whole, it may be most wise to hold the question an open one whether the water supply of the lake has been increased by a climactic change or by human agency. So far as we now know, neither theory is inconsistent with the facts, and it is possible that the truth includes both.[208]

At this point in his section, Gilbert took for granted that the climate was indeed changing in the region. And, if one were to follow his logic, this change would not be local but rather regional. It was pleasing for Gilbert to announce that "the theories best sustained by facts are those most flattering to the agricultural future of the Arid Region."[209] Of the three eventualities he offered for the future, one was negative – a cyclical return to desert conditions – and the other two were positive – a complete climactic change in the "advantageous direction" through natural processes, and that some part of settlement induces beneficial climactic changes that can be studied and made "more effectual."[210] Gilbert's comments contained within Powell's *Report* undermine the eternal arid nature

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[205] Powell and Stegner, *The Arid Lands*, 84.
[206] Powell and Stegner, *The Arid Lands*, 84.
[207] Powell and Stegner, *The Arid Lands*, 85.
[208] Powell and Stegner, *The Arid Lands*, 90.
[209] Powell and Stegner, *The Arid Lands*, 90.
[210] Powell and Stegner, *The Arid Lands*, 90-91.; Another example of using the geologic history of the West to see its future can be seen when Cyrus Thomas entertained the idea that the West was getting drier and that irrigation and forestry imports would be vital to the future of the West: Hayden, *Sixth Annual Report of the United States Geological Survey of the Territories*, 277-280.

of the West that would require revising the existing system of settlement. As a geologist, Gilbert could not deny the malleable nature of the West and was hesitant to use the limited scientific data available to overturn observed folk belief concerning climactic change.[211]

As indicated by Gilbert, Powell himself addressed the human-induced climate change theories that were circulating at the time of his *Report*. Once again, the usual suspects appeared: the railroad, telegraph lines, cultivation, and prayer.[212] Powell decided that none of these could definitively be proven. He also recognized why they were in such wide circulation and "obtain[ed] credence." These theories were worth Powell's time to address because they had power. For him, they had power as a result of ignorance. It was, according to Powell, because of a lack of information relating to the laws which govern aqueous precipitation."[213] In order to enlighten his audience, Powell explained, just as Gilbert had, that the climate is determined by a complex interconnected system. Humans, he said, were insignificant to this large system's operation. Powell stated, "the operations of man on the surface of the earth are so trivial that the conditions which they produce are of minute effect, and in presence of the grand effects of nature escape discernment."[214] Furthermore, Powell noted, "[t]he permanent changes of nature are secular; any great sudden change is ephemeral, and usually such changes go in cycles, and the opposite or compensating conditions may reasonably be anticipated."[215] Here Powell seems to destroy the idea of human agency in creating permanent climactic

[211] Smith, "Rain Follows the Plow," 182-183.
[212] Powell and Stegner, *The Arid Lands*, 104.
[213] Powell and Stegner, *The Arid Lands*, 104.
[214] Powell and Stegner, *The Arid Lands*, 105.
[215] Powell and Stegner, *The Arid Lands*, 105.

change. But Powell recognized a problem. He understood that if the change being seen was indeed cyclic, massive agricultural failure would ensue. Luckily, the "increase is abundantly proved; it is a matter of universal experience."[216] Water supply was increasing, but it was not the result of increased rainfall. Powell credited "artificial changes wrought by man on the surface of the earth" with causing the increasing amount of water in streams which added to the available water for irrigation.[217] This news, Powell pronounced, was even "more flattering to the future of agriculture" than rain following the plow.[218] Humans had the power to change some elements of the West in order to make it habitable.

Powell's plan for overhauling the existing patterns of settlement in the American West was aggressively countered by those who held fast to the vision of the garden-West.[219] He, as one of his admiring biographers stated, "believ[ed] in a modified Great American Desert" and "would resist with all his energy the tide of unreasoning, fantasy-drawn settlement and uncontrolled exploitation that the Gilpins explicitly or implicitly encouraged."[220] The problem was that the dream of a garden-West was too powerful and pervasive in the American imagination that it could not be easily undermined.[221] Science, and Powell's rival Hayden, supported a changing West where anything was possible. To

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[216] Powell and Stegner, *The Arid Lands*, 105.
[217] Powell and Stegner, *The Arid Lands*, 106.
[218] Emmons, *Garden in the Grasslands*, 174-182.; Powell and Stegner, *The Arid Lands*, 106.; Smith, "Rain Follows the Plow," 183-184.; Stegner, *Beyond the Hundredth Meridian*, 7, 321.
[219] However, some used his authoritative status and his words about the significance of human-induced changes expressed in his *Report* to boost for the West.; Emmons, *Garden in the Grasslands*, 176.; Also, geographer Scott Kirsch has shown us how Powell fits securely into the larger context of governmentality and the violent process of settling and dispossessing the West.; Scott Kirsch, "John Wesley Powell and the Mapping of the Colorado Plateau, 1869-1879: Survey Science, Geographical Solutions, and the Economy of Environmental Values," *Annals of the Association of American Geographers* 92, no. 3 (2002): 548-572.
[220] Stegner, *Beyond the Hundredth Meridian*, 7.
[221] Worster, *A River Running West*, 359.

take action on Powell's recommendations was tantamount to attacking America's exceptionalism and natural progress that was written in the rocks.

John Wesley Powell's *Report on the Lands of the Arid Region of the United States* may have been a truthful and enlightened document that spoke to settlement implications regarding the arid nature of the West, but it was not a convincing refutation of a progressively improving climate in the West.[222] Therefore, it is hard to imagine that his drastic recommendations would be taken seriously considering the beliefs regarding climate change and humanity's ability to alter the natural world. Changes could very well be taking place naturally or artificially, but they convincingly were taking place in the context of scant amounts of climate data and incomplete knowledge of hydrologic cycles. So why would legislators wish to or feel the need to alter the nature of the homestead system? Powell has been held up high by many western historians who agree with his assessment of the West's aridity. However, his veneration should be tempered by the fact that he was a man of his time and was unable to override and disprove the countervailing sentiment that the West was or would be a garden. He had made measures for a massive renovation of the land system without undermining the faith that had helped compose the original Homestead Act. The malleable earth that the science of geology had heralded was too strong of a force for him to control. Furthermore, the fossil fuel genie was out of the bottle and faith in a brighter future was triumphant.

[222] However, Wallace Stenger believed that Powell stood firmly against the garden vision of the West. See: Stegner, *Beyond the Hundredth Meridian*, 212.; Similarly Charles Kutzleb claimed that, "Powell's proposals ran counter to the belief that rainfall was increasing."; Kutzleb, "Rain Follows the Plow: The History of an Idea," 81-86.

Also, Powell's authority was in question as a power-struggle over government science was stirring. A growing pool of American scientists began to see the surveys of the West as their province and with a fiscally-minded Congress their time came to wrest control from the military. In 1878, the House Appropriations Committee began an inquest into concerns of overlapping explorations and possible consolidation in the interest of saving money. The Committee turned over investigations to the National Academy of Sciences. This proved to be the death knell of the military surveys and the birth of a civilian science-controlled United States Geological Survey (USGS) in 1879. Hayden's reputation for shoddy science set him as an inferior choice for heading this new administration.[223] As a newspaper in 1890 noted, "[t]here were really two geological surveys – Professor Hayden's practical and Major Powell's scientific."[224] The battle that ensued pitted Hayden against Powell who worked hard to see Clarence King obtain the privileged position.[225] A staunch rivalry raged on to the stage of American science and set up Powell for future failure.[226]

The first director, King, was better regarded by scientists and had many influential friends that secured his appointment. Like Hayden, King was pragmatic and set forth on turning the Survey's attention to mining and exploiting the resources of the West. Because the USGS was funded by the government, and the surveys did not require attention to military matters associated with exploring the unknown, the objectives of the

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[223] Cassidy, *Ferdinand V. Hayden*, 301.; Foster, *Strange Genius*, 338-352.; Stegner, *Beyond the Hundredth Meridian*, 205.
[224] "United States Geological Survey," *The Pittsburgh Dispatch*, December 5, 1890.
[225] For a great biography about the strange life of Clarence King, see: Martha A. Sandweiss, *Passing Strange a Gilded Age Tale of Love and Deception across the Color Line* (New York: Penguin Press, 2009).
[226] Henry Nash Smith, "Clarence King, John Wesley Powell, and the Establishment of the United States Geological Survey," *The Mississippi Valley Historical Review* 34, no. 1 (1947): 37-58.

Survey were directed primarily towards assessing the nation's natural resources. The role of scientists in this struggle also reveals their rising prominence on the national stage and as a powerful cultural force imbued with the authority of truth.[227] In antebellum America, Humboldtian science was more of a necessity than merely a philosophy of the practice of science.[228] After the War, the conquering of space enabled by the railroads and the expansion of industrialization served to advance the process of specialization of American science that fragmented the broad vision of Humboldtian science. Rapid industrialization and the attendant ever-growing consumption of energy had begun to show Americans the power of science and technology in dominating and harnessing the natural world.[229]

Powell followed King as director of the USGS. This added fuel to the fire of Hayden's hatred for his fellow geologist. While King was primarily concerned with industrial resources, Powell wished to find a way to reconcile the current land system with the practical application of agriculture to the West. The plan detailed above in his *Report*, however, was more of a boon for ranchers and cattlemen than for homesteaders and agriculturalists. Long's Great American Desert provided ample room for cattlemen to operate in the West without the interference of countless agriculturalists dotting their range.[230] Wilber had noted that the wealthy cattle interests would always favor the image

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[227] Goetzmann, *Exploration and Empire*, 488, 578-592.; William H. Goetzmann, *New Lands, New Men: America and the Second Great Age of Discovery* (New York: Penguin Books, 1987), 412-418.; Mary C. Rabbitt, *A Brief History of the U.S. Geological Survey* (Reston, VA: Dept. of the Interior, Geological Survey, 1975), 5-22.
[228] This is covered in Chapter 1.
[229] For energy consumption in America, see: Martin V. Melosi, *Coping with Abundance: Energy and Environment in Industrial America* (Philadelphia, PA: Temple University Press, 1985).; David E. Nye, *Consuming Power: A Social History of American Energies* (Cambridge, MA: MIT Press, 1998).
[230] Hollon, *The Great American Desert Then and Now*, 131.

of the desert because it favored their aims to retain large tracts of land.[231] The ranching lobby was powerful in the West because the idea of the western desert dominated the public imagination up until the conclusion of the Civil War and they were able to enter the region with minimal intrusion from agriculturalists.[232] Along with Powell, ranchers often rejected Wilber's rain follows the plow prophesy.[233] Powell had granted an extension to Long's vision and allowed for the possibility that the advantage that cattlemen counted on would be formalized into law.[234]

A further indication of their polar positions and enmity towards each other was that the two men found themselves on either side of the "Bone Wars." Hayden had allied with Cope, and Powell with Marsh. In many ways, Hayden-Cope and Powell-Marsh represented the two sides of American opinion as it regarded science and settlement in the late nineteenth century. There was obvious value in science's utilitarian application and in fostering hopes for America's unlimited and untapped potential, and there was also a growing recognition of the power of basic science and its desirability in displaying American prestige and cultural refinement. The authority of disinterested science was becoming a prominent feature of American life as the nation entered into the Progressive Era. There had been an abundance of pseudoscience and charlatanry, not the least in the boosting of the American West. But science had shown its power in transforming the natural world and performing miracles in the energy abundant industrial age. As we have

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[231] Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest*, 144.
[232] Hollon, *The Great American Desert Then and Now*, 131.
[233] Smith, "Rain Follows the Plow," 190-191.; Many advocates of western agriculture saw ranching as a temporary step in the evolution of life in the West. For more on the debate between farmers and ranchers in the West pertaining to "Rain Follows the Plow," see: Emmons, *Garden in the Grasslands*, 147, 186-198.; Kutzleb, "Rain Follows the Plow: The History of an Idea," 156.
[234] Hollon, *The Great American Desert Then and Now*, 146-147.

seen Hayden and Cope believed in the advancing settlement of the West, whereas Powell embraced its limits. Americans enamored with the garden-West and naturalistic theories of progressive climate change were far more likely to side with Hayden and Cope.[235] For the time being, the public preferred providence to Powell's technocratic restructuring of the West.

Powell's ambitious plans for the "Arid West" were undermined in more than one way by scientists studying the geology of the region. As we have seen above, geology played a large role in climate change discussions and gave credence to the belief in a malleable environment that may be naturally improving. The science of geology also played a role in embroiling Powell in controversy as director of the USGS. It would prove the death knell of his prominence and much of his vision for revising land tenure in the West. In a wider historical sense Powell's demise was a sacrifice in the rising philosophy of Progressivism as it sought to displace naturalistic *Laissez Faire* social and economic theories that typified the rapid industrialization of American after the Civil War. Powell was a Progressive while his opponents were reluctant to reform.

The influence of the very public "Bone Wars" between Othniel Marsh and Edward Drinker Cope, who collected extensively from the West during the 1870s and 1880s, harmed paleontology as a science with their public vitriol. Because of their association with the government surveys and their leaders these men also affected the course of western settlement and land law.[236] The 1880s were when these conditions came to a head and played out in Powell's professional life. The Allison Commission and

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[235] Kutzleb, "Can Forests Bring Rain to the Plains?," 18.
[236] David Rains Wallace, *The Bonehunters' Revenge: Dinosaurs, Greed, and the Greatest Scientific Feud of the Gilded Age* (Boston, MA: Houghton Mifflin, 1999), 10.

the Irrigation Committee in the U. S. Congress brought Powell's arid West and his administration of the USGS into the public spotlight. Interestingly enough, fundamentalist congressman Hilary Herbert of Alabama was given information by Hayden and Cope with which to assail Powell.[237] Some of the members of the Allison Commission (1884-1886), formed to evaluate public funding for science, used their negative perception of theoretical geology and paleontology and their belief that it was not useful science to argue for reduced government patronage for the USGS.[238] However, Powell noted the money saved through close relationships with railroads, responded ably to attacks on his administration its science, and essentially arose victorious from this contest making room for science to continue to be practiced under the patronage of the Federal Government.[239]

Regardless of the victory for government science, the Allison Commission showed his enemies that Powell was indeed vulnerable and they waited for the opportunity to continue to pursue his destruction.[240] Their chance came with his public failure in surveying the West's potential for irrigation. Born from blizzards during the winter of 1886-7 that killed herds of cattle and drought in 1887 that left farmers scratching their heads, an Irrigation Committee was formed and granted Powell powers

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[237] A. Hunter Dupree, *Science in the Federal Government: A History of Policies and Activities* (Baltimore, MD: Johns Hopkins University Press, 1986), 222.
[238] Dupree, *Science in the Federal Government*, 213-231.; In 1890, a Pittsburgh newspaper singled out paleontological science in the surveys and criticized the "fat appropriations for paleontological information" and was concerned about the conversion of "a temporary appropriation for scientific work into a permanent bureau of fat salaried sinecures."; "United States Geological Survey."
[239] Dupree, *Science in the Federal Government*, 228-230.; Goetzmann, *Exploration and Empire*, 595-596.; Vetter, "Science Along the Railroad: Expanding Field Work in the Us Central West," 204.
[240] In 1890, Cope had already begun this process with an extremely public attack on Marsh and Powell published in newspapers. See: Stegner, *Beyond the Hundredth Meridian*, 324-328. "Scientists at War. Charges Made against the Geological Survey and Its Director," *The Evening Star*, January 13, 1890.

of putting together an irrigation survey of the West. Unfortunately it was structured in such a way that made Powell too powerful in the eyes of western irrigation interests who were too impatient for him to finish his survey of the West's water resources.[241] Powell's dominion over the future of western settlement was unsettling to many Americans. These western interests moved fast and their Congressional representatives cut Powell's funding and in effect killed his irrigation survey.

This defeat opened up a window for his enemies. Powell could not escape the shadow cast by Marsh and the adversaries he had generated through advocating an alternative vision for the West.[242] In 1893, Herbert again attacked Powell and derided his associate Marsh as a "Godless" Darwinists, and paleontological research was mocked with Herbert's catchphrase "Birds with Teeth!" after reviewing the budget for the U. S. Geological Survey.[243] It is not hard to imagine the grip of scripture that persisted while during this period paleontologists had not attained consensus regarding the mechanism of evolution.[244] Debate could give rise to suspicion and allow other explanations a degree of credibility.[245] Theological implications of geology and paleontology also raised concern, especially in the context of Darwinian evolution. But, perhaps more importantly, the question arose as to whether the government should be funding such basic research with no clear utilitarian goal. The answer to this question was soundly proclaimed when

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[241] Dupree, *Science in the Federal Government*, 232-234.; Goetzmann, *Exploration and Empire*, 596-599.; Stegner, *Beyond the Hundredth Meridian*, 328-338.
[242] Mark Jaffe, *The Gilded Dinosaur: The Fossil War between E.D. Cope and O.C. Marsh and the Rise of American Science* (New York: Crown, 2000), 290-296, 335-347.
[243] Dupree, *Science in the Federal Government*, 235.; Robert West Howard, *The Dawnseekers: The First History of American Paleontology* (New York: Harcourt Brace Jovanovich, 1975), 255.; A similar circumstance occured in California in the 1860s. See: Goetzmann, *Exploration and Empire*, 372.
[244] Martin J. S. Rudwick, *The Meaning of Fossils: Episodes in the History of Paleontology* (Chicago, IL: University of Chicago Press, 1976), 255.
[245] A contemporary example of this is climate change.

Powell's USGS suffered a severe budget cut that handicapped its ability to practice science. Powell soon resigned in 1894 and this episode effectively put an end to him directing his dreams of a redesigned and irrigated West.[246] The geology of the West could easily become embroiled in politics and be mustered on behalf of those who dreamed of the garden-West and were interested in maintaining the *status quo*.

Conclusion

In the decade that followed the Civil War, science yielded evidence that supported a fluid western environment. The USGS surveys sent out information to the American public that spoke of the possibility to remake the West into an agricultural Eden. The media and popularizers of science brought this knowledge to a wider audience and encouraged the railroads to use climate change theories as a lever to move settlers onto their western lands. According to scientific opinion, civilization simply had to come to the desert wilderness and it would suddenly change through natural processes. When some confronted the brutal aridity of the region, they questioned this logic. However, they could not kill the dream of an agricultural West which was infused with the authority of science. Only time in the arid West would work to undue this dream.

In the end, it was not Powell who halted the hopes for rain following the plow; it was the eventually undeniable natural climactic character of the West. Also, as America entered into the technoscientific age of the Progressive Era, the West's natural malleability mattered less. The human capacity to remake the world through science and

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[246] Dupree, *Science in the Federal Government*, 235.; Thomas G. Manning, *Government in Science: The U.S. Geological Survey, 1867-1894* (Lexington, KY: University of Kentucky Press, 1967), 30-59, 122-150.; Stegner, *Beyond the Hundredth Meridian*, 340-345.

technology had begun to take on new social, cultural, and political significance. Cyclical drought throughout the 1880s and 1890s proved that rain had not followed settler attempts to reclaim the land through simple cultivation.[247] With historical hindsight we can see that Powell was right about expanding the size of homesteads in the West. Drought had primarily destroyed the typical 160 to 320 acre plots, while larger farmers were better able to withstand the climactic extremes of the West.[248] The belief seemed to have been laid to rest around 1895 as it faced drought, a more complete scientific picture of the western climate, and the rise of alternative technological and scientific solutions to the West's aridity that would get water to the otherwise fertile soil.[249] Regardless of its malleable deep past, nature would not bend to the movement of American settlement.

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[247] Davidson et al., "Gleanings from H-West: Rain Follows the Plow," 93.; Kutzleb, "Rain Follows the Plow: The History of an Idea," 153-154.; Smith, "Rain Follows the Plow," 191.

[248] Libecap and Hansen, ""Rain Follows the Plow" and Dryfarming Doctrine," 89, 95.

[249] As a result of the larger populations in the West and better weather observation and theory, the science of meteorology began to establish a more complete picture of the West and scientists were hesitant to place their support behind the supposed natural effect of cultivation or "civilization" on western rainfall. For example, as James Fleming has shown, weather data expanded in tandem with the expansion of the transcontinental railroads and western telegraph systems. Furthermore, amateurs were vital to gathering weather data in the quantities required to make meaningful assessments of the western climate. As these technological systems and networks of collaborators expanded with settlement in the West, more data flowed in for scientists to interpret. Nevertheless, this took some time to fully develop and take effect in how Americans understood the western climate. In the decades immediately following the Civil War, western weather data was sparse. This resulted in what Gary D. Libecap and Zeynep Kocabiyik Hansen termed "the weather-information problem" that homesteaders faced in deciding to settle in the West. This made for steep learning curves in adjusting to the real climactic conditions of the West and often in failure. They concluded that this problem "was especially acute because of the climactic conditions on the Great Plains, the lack of systematic data to describe them, and the absence of an analytical model for interpreting available information." The theory that "Rain Follows the Plow" emerged from this dearth of data. By 1885, data was accumulating and scientists began to demand more rigorous analyses of newly available climactic data in order to draw conclusions about the West. This is not to say that the science produced previous to this shift was pseudoscience. The work of Hayden and his colleagues was good science given the data that they had at that time. The conclusions that they made would, in time, be amended with the accumulation of more data, different methods, and new cultural imperatives, like all scientific statements.: Kutzleb, "Rain Follows the Plow: The History of an Idea," iii, 33-36, 129, 189, 231, 216-217.; Kutzleb, "Can Forests Bring Rain to the Plains?," 20-21.; Libecap and Hansen, ""Rain Follows the Plow" and Dryfarming Doctrine," 1890-1925," 87-88, 92-93, 96.; For information on early meteorological stations in the West, see: Fleming, *Meteorology in America*, 76, 81, 86-89, 133, 141-162, 170-172.; Hargreaves, *Dry*

The last ditch effort to get the rains to cooperate came about as a result of the observed effects of human-induced particulates added to the atmosphere. The "rainmakers" as they would be called, were the product of the emerging fossil-fueled Progressive Era faith in science and technology to manipulate the natural world and the fragmented remains of hope lingering to bring rains to the western Plains. One of the first to attempt to put rainmaking into action was James Espy who was one of the three individuals embroiled in the 1834-1843 dispute about the causes of American storms called the "American storm controversy."[250] Espy worked to apply his knowledge of American storms to the practical ends of artificial rainmaking and, much to the dismay of his scientific colleagues, advertised his results to the public. While he was shunned by scientist, Espy received good press for his idea that human-set fires could produce localized rain events. He had derived his theory through his understanding of the atmosphere as driven by heat energy and through the observed fact that rains tend to increase following volcanic eruptions.[251] Espy likened the effects of great forest fires to that of a volcanic eruption and to prove his theory, he set fire to impressively large sections of forests in places like Fairfax County, Virginia. Unfortunately for Espy and his hopeful public, more often than not he failed to produce rainmaking results.[252] The idea nevertheless remained relatively dormant in agricultural circles until hopes of a naturally

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Farming in the Northern Great Plains, 54-56.; Mock, "Rainfall in the Garden of the United States Great Plains, 1870-1889," 178-181.

[250] Fleming, *Meteorology in America*, 23-24.

[251] Fleming, *Fixing the Sky*, 53, 56.

[252] James P. Espy, *The Philosophy of Storms* (Boston, MA: C.C. Little and J. Brown, 1841).; Fleming, *Fixing the Sky*, 7, 53-58.; Fleming, *Meteorology in America*, 25, 43-45, 66, 71-72, 99.; Kutzleb, "Rain Follows the Plow: The History of an Idea," 28.; Clark C. Spence, *The Rainmakers: American "Pluviculture" to World War II* (Lincoln, NE: University of Nebraska Press, 1980), 9-21;

changing climate were dashed and the desert-West threatened to return to dominate the American imagination.

Rainmaking's heyday during the 1890s coincided with the silencing of the mantra rain follows the plow that occurred in large part due to repeated droughts and widespread agricultural failure in the West.[253] The shift that transpired was from a "natural," and often geohistorically informed, to a human directed and "scientifically" informed method of climactic change or what could be considered early geoengineering.[254] It was rain follows the plow with a Progressive Era spin. The always controversial theories included the use of water vapor, steam from the railroads, explosives, chemicals, mysterious substances, balloons, and electricity to generate rain on demand through human agency.[255]

For example, a publication that received a significant amount of press was the 1871 book *War and the Weather, or, The Artificial Production of Rain* by Edward Powers. Powers correlated rain events with the firing of artillery in battles and believed that this effect could be generated by producing explosions in the atmosphere through the use of balloons.[256] In 1890, as rainmaking was making a significant showing on the national scene, Powers published a revised edition of his text.[257] The fact that Powers could republish his findings twelve years later illustrates the noteworthy popularity of rainmaking theories and their attractiveness to the public in the 1890s. In 1891, it was

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[253] Fleming, *Fixing the Sky*, 86.
[254] Kutzleb, "Rain Follows the Plow: The History of an Idea," 250.; Webb, *The Great Plains*, 378.
[255] Kutzleb, "Rain Follows the Plow: The History of an Idea," 252-328.; Spence, *The Rainmakers*.; Smith, "Rain Follows the Plow," 191-192.
[256] Fleming, *Fixing the Sky*, 59-76.; Kutzleb, "Rain Follows the Plow: The History of an Idea," 33-36, 61, 63.
[257] Edward Powers, *War and the Weather*, Revised Edition (Delavan, WI: E. Powers, 1890).

reported that it Powers had derived his theory "[f]rom certain scientific data" and soon it would be a cost effective method of saving crops from drought.[258] Unsurprisingly, these efforts were supported by boosters such as the western railroads who also favored rain follows the plow.[259] Rainmaking prolonged the hopes for a malleable West and bridged the gap between rain follows the plow and reclamation.[260]

While his report did not remake the West as he had intended it, Powell's position on irrigation would be represented in future Federal policy. The Preface to Powell's *Report* revealed his optimism in engineering the West for settlement. "The redemption of the Arid Region," Powell declared, "involves engineering problems requiring for their solution the greatest skill."[261] For "the arid lands, so far as they can be redeemed by irrigation, will perennially yield bountiful crops."[262] With wisdom, cooperation, and ingenious engineering skill the West's arid lands could be "rescued from their present worthless state."[263] The farmers of the West could not do it themselves. Along with expert engineering and planning, they would require, Powell believed, supportive legislation along with "aggregated capital or cooperative labor."[264] The reclaiming of the West would be a monumental feat requiring the apparatus of the state and technocrats to direct large-scale irrigation projects for western settlers. Powell has been credited with

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[258] "Producing Rainfall," *Princeton Union*, May 14, 1891.
[259] Fleming, *Fixing the Sky*, 87.; Webb, *The Great Plains*, 378-382.
[260] It is important to note that attempts to artificially change the climate did not disappear after this surge in the 1890s. They persisted through the twentieth century and continue today in discussions about technofixes for global climate change.; Eli Kintisch, *Hack the Planet: Science's Best Hope – or Worst Nightmare – for Averting Climate Catastrophe* (Hoboken, NJ: Wiley, 2010).; Fleming, *Fixing the Sky*; NPR Staff, "Geoengineering: 'A Bad Idea Whose Time Has Come,' *NPR*, May 29, 2010, accessed October 24, 2014, http://www.npr.org/templates/story/story.php?storyId=127245606.; Spence, *The Rainmakers.*; Mark Strauss, "The Military Is Shutting Down Its Weather-Controlling Death Beam," *io9*, May 22, 2014.
[261] Powell and Stegner, *The Arid Lands*, 7.
[262] Powell and Stegner, *The Arid Lands*, 8.
[263] Powell and Stegner, *The Arid Lands*, 8.
[264] Powell and Stegner, *The Arid Lands*, 8.

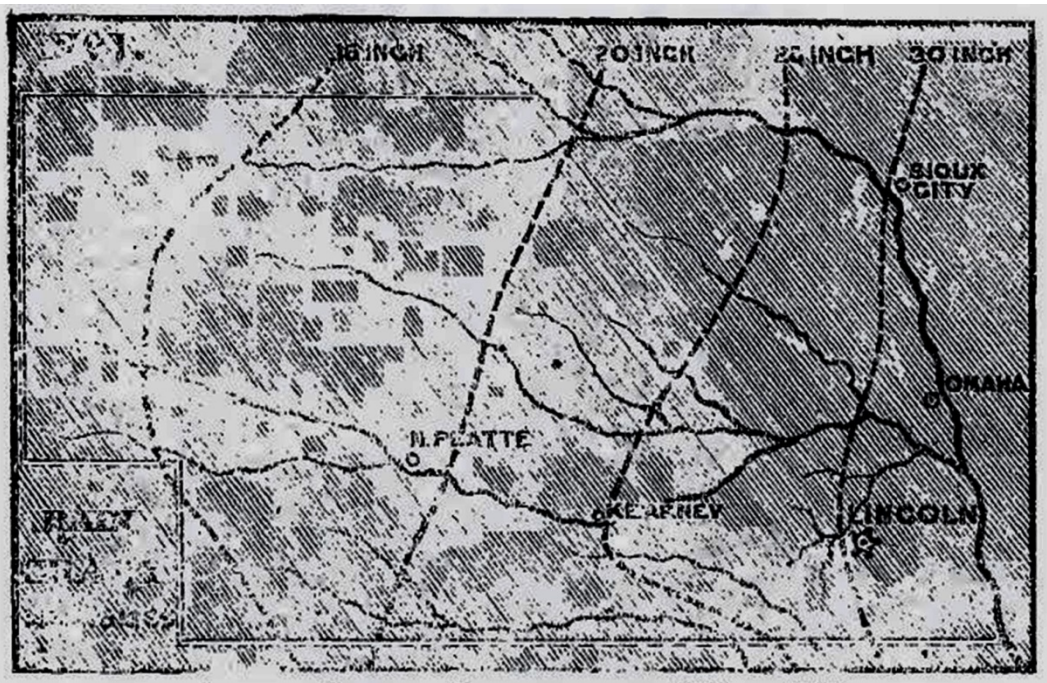
being the source of the "outgrowth" of irrigation concerns in the arid West that resulted in the 1902 Reclamation Act.[265] Yet, while Powell did not necessarily support a national reclamation program, his Preface did speak to the possibility of making a garden from the desert and therefore continued to support the hope that the West would be remade by the human hand.[266] The garden would not sprout spontaneously from the ground; it would have to be coaxed through wise management and enlightened engineering. The Earth was plastic, but it seemed by this point to not be naturally altered by the advance of settlement. It would take the powers of industrial society to make the West bend to man's will. Garden hopes did not shrivel and die in the face of drought, they adapted to the dry conditions and took on Progressive Era traits.

With the rise of increased climatological knowledge and a more complete understanding and acceptance of geology and paleontology as authoritative sciences, the notion of a rapidly changing climate became less tenable. A natural progression was replaced with a mechanical or technologically-induced change or adaptation to conditions that stood in the way of westward progress and the advance of industrial civilization. It was providential that humans had the capacity for dominion over nature, not simply that nature would change itself to human needs. If nature would not adapt, humans would adapt nature. Humanity would remake the world.

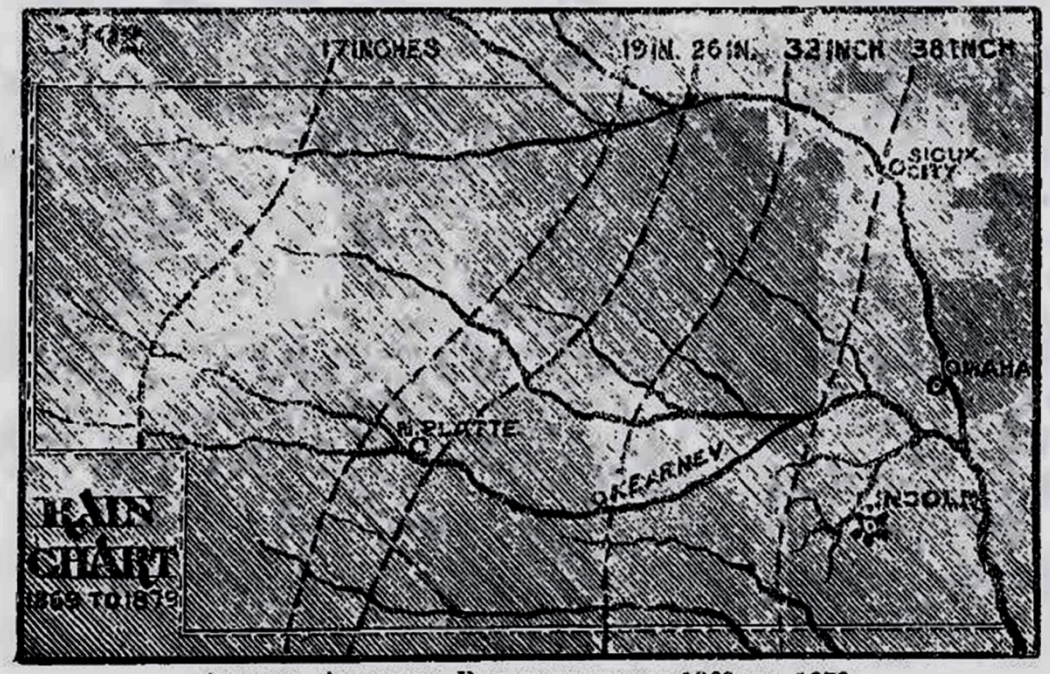
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[265] F.H. Newell, *Third Annual Report of the Reclamation Service, 1903-4* Second Edition, Department of the Interior, United States Geological Survey (Washington: Government Printing Office, 1905), 39.; His picture is featured prominently opposite the title page in an early history of the United States Reclamation Service. The history also refers to him as the "Father of the U.S. Reclamation Service" and possessing "a prophet's superhuman vision."; George Wharton James, *Reclaiming the Arid West: The Story of the United States Reclamation Service* (New York: Dodd, Mead and Company, 1917), 2.

[266] Donald J. Pisani, *To Reclaim a Divided West: Water, Law, and Public Policy, 1848-1902* (Albuquerque, NM: University of New Mexico Press, 1992), 145.; Powell believed in a regional rather than a national perspective and approach to reclaiming the West: Donald Worster, *An Unsettled Country: Changing Landscapes of the American West* (Albuquerque, NM: University of New Mexico Press, 1994), 20.

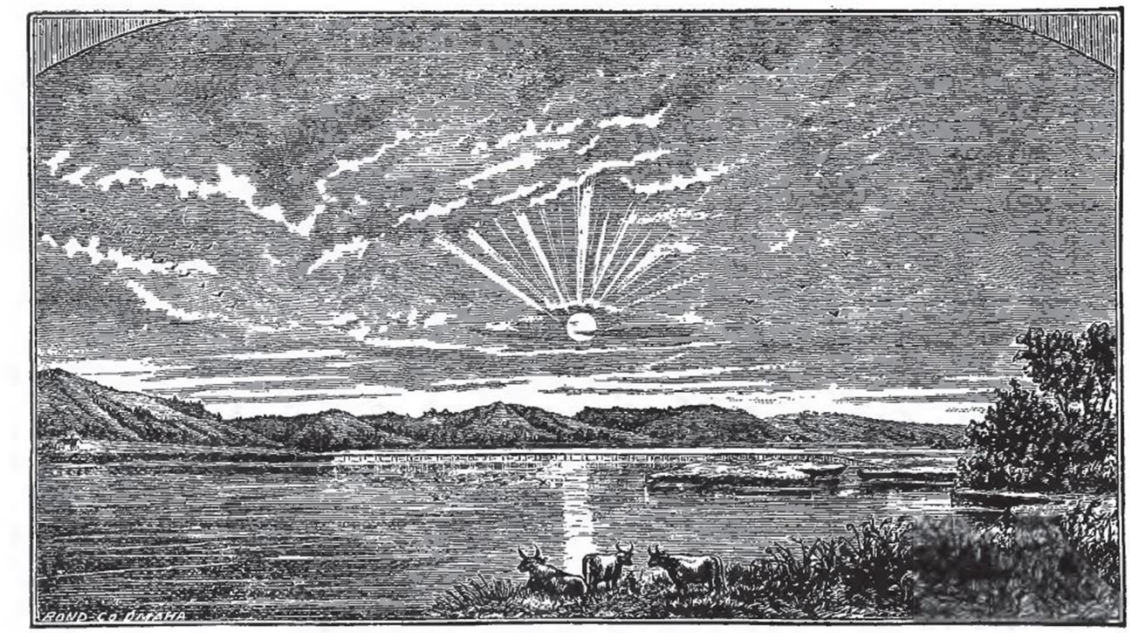


ANNUAL AVERAGE RAINFALL FROM 1859 TO 1869.



ANNUAL AVERAGE RAINFALL FROM 1869 TO 1879.

Figure 51. Rain Chart from Wilber. Source: Charles Dana Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest* (Omaha, NE: Daily Republican Print, 1881), 77.



PLATTE RIVER, NORTH BEND, DODGE COUNTY, NEBRASKA.

Figure 52. Scene from Nebraska, Wilber. Source: Charles Dana Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest* (Omaha, NE: Daily Republican Print, 1881), 245.

RECLAIMING THE GARDEN BY FORCE

> Thus, when water becomes scarce on earth, as it is now on Mars, future Americans can employ themselves by lining the canals with concrete, provided they have not already learned how to grow crops in air.[1]
> ~"A New Wonder for Irrigation in the West," *New York Times*, February 6, 1910.

Between May 24, 1894 and April 3, 1895, Percival Lowell peered into the clear desert night sky through his telescope from his observatory in Flagstaff, Arizona, and saw something that shocked him.[2] There were clearly canals on the dusty surface of Mars. The American media reported widely on his discoveries and Lowell became a scientific celebrity. Lowell believed that Mars was proceeding through a process of planetary death that would be repeated on Earth. It was no coincidence that he saw an elaborate set of irrigation works on Mars at the same time that America was entering into a phase of irrigation fever focused on the arid West. Federal reclamation was on the horizon and it was increasingly evident that the only way to successfully settle the West was through large-scale irrigation. In high-energy America, the arid wastes of the West could be restored using science and technology.

This chapter will demonstrate the use of science, technology, and fossil fuels to find solutions to the arid West so that Americans could continue to view it as malleable. As rain follows the plow became an untenable dream, geology continued to be a significant element of how the region's past and future were conceived. It will begin by examining how Percival Lowell used Mars to talk about the fate of Earth and the

[1] "A New Wonder of Irrigation in the West," *New York Times*, February 6, 1910.
[2] Percival Lowell, *Mars* (New York: Houghton, Mifflin and Company, 1895).

necessity of irrigation. The science of irrigation came to the fore as rain follows the plow fell out of favor in the face of persistent drought. Through the work of William E. Smythe, the next section will focus on the social and soil science of the irrigation movement of the late nineteenth and early twentieth centuries. The State soon stepped in with the Carey Act and attempted to irrigate lands in arid states like Montana. As the case study in this chapter will demonstrate, often these efforts failed. At the turn of the century, the Reclamation Act was passed and took on projects of immense scale such as the one that Buffalo Bill started in Cody, Wyoming. Geology pervaded these discussions as Cody chose his site based on an ancient lake deposit, and with the aid of fossil fuels the Reclamation Service was seen as performing the work previously done by geologic processes. The Milk River Reclamation project in Montana serves as an illustration of the scale of the social and environmental impacts of reclamation. Lastly, the chapter will examine the dry farming movement's origins in previous theories of western climate change and the role of Montana's railroads in continuing to boost for the West and spread visions of an agricultural paradise.

Percival Lowell, Planetary Dewatering, and Reclamation

As Federal Reclamation was being conceived in the late nineteenth and early twentieth centuries, Mars became an example of how environmental stewardship on Earth should work. At turn of the nineteenth century, the red planet served as an example of technological expertise in reclaiming a desiccated landscape here on Earth. At the same time that the American West was escaping out from under the oppressive influence of the Great American Desert and thoughts of using technology to reclaim the garden-

West were in vogue, Mars began to creep into the public consciousness. Through late nineteenth and early twentieth century telescopes, the landscape of Mars was perceived as covered with canals and sophisticated planetary irrigation serving to water a dying planet. Through the work of Percival Lowell, this section will demonstrate that the geology of the West could be used to paint a picture of environmental decline. A significant point here is that the implications of geological history depended on cultural context and the historical moment in which it was being interpreted. The conclusion drawn from the picture sketched by the rocks and painted by culture demonstrated to Lowell and his contemporaries that arid environments like those found in western America necessitated technocratic government intervention for their future survival. The future of humanity's relationship to the environment was one of absolute mastery that could have only been conceived of in a culture empowered with fossil energies.

In 1895, Percival Lowell, the most potent nineteenth century American figure conveying knowledge of Martian life, wrote the book *Mars*, which detailed his out-of-this-world theories that revolved around irrigation.[3] He worked from an observatory in the arid lands of Flagstaff, Arizona, and gazed through the clear skies to bear witness to the wonders of Mars. Lowell assured his readers that despite the planet's desert landscape, Mars was "not antagonistic to some form of life" and owing to evidence of

[3] Michael J. Crowe, *The Extraterrestrial Life Debate, 1750-1900: The Idea of a Plurality of Worlds from Kant to Lowell* (New York: Cambridge University Press, 1986), 506-546.; William Graves Hoyt, *Lowell and Mars* (Tucson, AZ: University of Arizona Press, 1976).; K. Maria D. Lane, "Geographers of Mars: Cartographic Inscription and Exploration Narrative in Late Victorian Representations of the Red Planet," *Isis* 96, no. 4 (2005); K. Maria D. Lane, *Geographies of Mars Seeing and Knowing the Red Planet* (Chicago, IL: University of Chicago Press, 2011).; Robert Markley, *Dying Planet: Mars in Science and the Imagination* (Durham, NC: Duke University Press, 2005).; David Strauss, *Percival Lowell: The Culture and Science of a Boston Brahmin* (Cambridge, MA: Harvard University Press, 2001).; Lowell was not the first to speak of canals on Mars through telescopic observation. The Italian scientist Giovanni Schiaparelli was the first to discover "canali" on Mars. See: Crowe, *The Extraterrestrial Life Debate*, 480-546.

massive irrigation works, this life was indeed intelligent.[4] Using the nebular hypothesis to trace the planetary life of Mars, Lowell deduced that due to its smaller size in comparison to Earth, the planet cooled earlier and the process of Martian evolution began at a much earlier date.[5] "Mars being thus old himself," Lowell explained, "we know that evolution on his surface must be similarly advanced."[6] Combining theories of environmental determinism and social Darwinism, he surmised that Martians would be further along the progressive scale of social evolution.[7] Their intelligence was written on the surface of the planet in the form of canals. Martian irrigation "handicraft" signaled "a highly intelligent mind behind it."[8] They were not only technologically adept, but also politically superior. Lowell believed that the "various departments of our own public works" could not have constructed the system of irrigation that he witnessed. The Martian system clearly illustrated that "[p]arty politics, at all events, have had no part in them; for the system is

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[4] Lowell, *Mars*, 201.
[5] Lowell, *Mars*, 206-208.; The hypothesis that Mars cooled more quickly than Earth has also been entered into today's discussions of terraforming the planet. For an example, see: Bruce Dorminey, "Can Mars Be Terraformed? Nasa's Maven Mission Could Provide Answers," *Forbes*, May 29, 2013.; For more information on the Nebular Hypothesis, see: Ronald L. Numbers, *Creation by Natural Law: Laplace's Nebular Hypothesis in American Thought* (Seattle, WA: University of Washington Press, 1977).
[6] Lowell, *Mars*, 208.
[7] For the most complete description of Lowell's views on evolutionary matters, see: Strauss, *Percival Lowell.*; Lowell, *Mars*, 210-212.; His commentary in this regard brought him one of his fiercest opponents – Alfred Russel Wallace. See: Alfred Russel Wallace, *Is Mars Habitable? A Critical Examination of Professor Percival Lowell's Book "Mars and Its Canals," with an Alternative Explanation* (London: Macmillan and Co., Limited, 1907).; Lane, *Geographies of Mars Seeing and Knowing the Red Planet*, 170-174.; For information on the influence of social Darwinism in America, and the coopting of Darwin's theories, see: Robert C. Bannister, *Social Darwinism: Science and Myth in Anglo-American Social Thought* (Philadelphia, PA: Temple University Press, 1979).; D. P. Crook, *Darwin's Coat-Tails: Essays on Social Darwinism* (New York: Peter Lang, 2007).; Richard Hofstadter, *Social Darwinism in American Thought* (Boston, MA: Beacon Press, 1955).; Barry Werth, *Banquet at Delmonico's: Great Minds, the Gilded Age, and the Triumph of Evolution in America* (New York: Random House, 2009).
[8] Lowell, *Mars*, 208.

planet wide."[9] Their planetary irrigation system showed that the ancient Martians were politically wiser and technologically superior to humanity.[10]

Lowell's later works expanded some of his hypotheses. In order to support his claims he entered into the realm of comparative geology using the nebular hypothesis as his starting point. In *Mars as the Abode of Life* (1908), and *Mars and its Canals* (1911), Lowell considered the geological study of the Earth to be of direct use to understanding the geologic history of Mars.[11] The red planet's small size forced it to age more rapidly than the Earth and could therefore play the role of "prophet…foretelling our future."[12] The life-cycle of a planet, according to Lowell, ended with a death by gradually drying out. A planet's natural tendency was a transition from a "terraqueous to a purely terrestrial condition."[13] Lowell called upon the geologic maps of North America contained within James Dwight Dana's *Manual of Geology* to support this theory [Figure 53].[14] The geologic maps, as Lowell interpreted them, illustrated North America's gradual shedding of a watery veil.[15] Fossilized trees in Arizona's Petrified Forest spoke to Lowell telling him of the conifers that once thrived during the watery Cretaceous.[16] These trees were evidence of a formerly fertile landscape in what was then a desert. Furthermore, the nature of fossilization that results in the marine bias in the fossil record (discussed in Chapter 4) affected his vision. Lowell believed that the relative lack of

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[9] Lowell, *Mars*, 209.
[10] Percival Lowell, *Mars and Its Canals* (New York: The Macmillan Company, 1911), 377.
[11] Lowell was so enamored with the nebular hypothesis that, according to historian Michael J. Crowe, when graduating from Harvard in 1876 he "contributed to his commencement exercises by an address entitled 'The Nebular Hypothesis'."; Crowe, *The Extraterrestrial Life Debate*, 465.
[12] Percival Lowell, *Mars as the Abode of Life* (New York: The Macmillan Company, 1908), 111.
[13] Lowell, *Mars and Its Canals*, 128.
[14] Lane, *Geographies of Mars Seeing and Knowing the Red Planet*, 157.
[15] Lowell, *Mars as the Abode of Life*, 112-124.; Lowell, *Mars and Its Canals*, 127-147.
[16] Lowell, *Mars as the Abode of Life*, 126.

terrestrial fossils found embedded in the Earth provided additional evidence for the dewatering of the Earth.[17] The material remains of geologic time were put to use in yet another way. This time the watery past of the West was used to support the vision of a dying planet and promote a tale of enlightened environmental management on a planet plagued by aridity.[18]

The Earth's geologic history illustrated that it was in the process of losing its youthful well-watered appearance and becoming old, dusty, and dry. The watery deep past of North America, and its current terrestrial state showed Lowell that water would soon be a precious resource. The growing deserts had an "unescapable death-grip on our world."[19] The Martians themselves were on their last leg as a species and soon Mars would "roll a dead world through space, its evolutionary career forever ended."[20] Yet, a moment of hope drifted into Lowell's despair as he recognized that challenge of arid places was a fact "to which we are constructively pledged and into which we are in some sort already adventured."[21] Government-sponsored reclamation was underway and imposing technological force on the landscape in order to stay humanity's inevitable environmental challenge. Survival would surely be granted to the fittest who adapt to this dry world.

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[17] Lowell, *Mars and Its Canals*, 140.
[18] Henry Nash Smith used the work of Arnold J. Toynbee to describe the "opposite mood of the American frontier." The idea of 'cosmic senescence,' or a decline in a society ascribed to natural causes was characteristic of the "decadent period of the Hellenic civilization" the naturally derived progress of the American nation was ascendant at the conclusion of the Civil War. However, Lowell's commentary on natural planetary death reveals that the concept of 'cosmic senescence' was informing some visions of American society's relationship to nature at the commencement of the twentieth century.; Henry Nash Smith, "Rain Follows the Plow: The Notion of Increased Rainfall for the Great Plains, 1844-1880," *Huntington Library Quarterly* 10, no. 2 (1947): 169-170.
[19] Lowell, *Mars as the Abode of Life*, 124.
[20] Lowell, *Mars as the Abode of Life*, 216.
[21] Lowell, *Mars as the Abode of Life*, 124.

Lowell's views passed into the minds of the public through the press and were widely accepted until at least WWI [Figure 54].[22] A *Washington Post* reporter in a 1913 article titled "The Tragedy of Life on Mars" nicely summed up his interpretations. After describing the gradual and inevitable death of Mars, the reporter explained how the environment has shaped Martian culture. Life on Mars was "battling against final extinction" and for Martians, "it has become simply a question of brain power against the inanimate powers of nature." These highly intelligent beings had "developed a command over natural forces which would seem miraculous if exhibited on earth." The author understood this mastery to have arisen out of a "reign of universal peace…introduced not by moral or sentimental considerations, but by the necessity of uniting all the engineering skill, all the inventive powers, and all the physical forces of the entire population." Earthlings were more primitive, the author reflected, and noted that "[t]his universal concentration of mental energy upon a single aim is conceived as having developed upon Mars a knowledge of the hidden forces of nature, such as has, up to the present merely

[22] Markley, *Dying Planet*, 105.; For examples of the abundant reporting concerning Lowell's theories, see: "The Mighty Men of Mars," *The Washington Post*, August 7, 1895.; "An American Astonomer's Views on the Habitability of the Planet Mars," *San Francisco Chronicle*, November 22, 1896.; "What the Martian May See on Earth," *San Francisco Chronicle*, February 23, 1896.; London Times, "Canals on Mars. Further Proof That They Have Actual Material Formation," *New York Times*, January 2, 1906.; ""Something Like Human Intelligence on Mars": Observations Made by Prof. Todd in the Andes Give Rise to the Interesting Theories of Life on Neighboring Planet," *New York Times*, October 27, 1907.; Hector Macpherson, "The Theories Concerning Mars," *San Francisco Chronicle*, July 28, 1907.; "Thinking Vegetable of Mars: Remarkable Theory of Prof. Campbell of Lick Observatory, Regarding Sister Planet," *The Washington Post*, October 13, 1912.; "Truck Gardens on Mars. Martian Expert Abandons Canal Theory and Suggests That Markings Are Due to Farming," *San Francisco Chronicle*, October 22, 1916.; "Prof. Lowell Dies: Martian Theory His," *New York Times*, November 14, 1916.; His work also entered into the literature of Edgar Rice Burroughs who wrote a series of books centered on Mars, which cast the planet in the midst of a multi-tiered civil war as result of water scarcity.; Lane, *Geographies of Mars Seeing and Knowing the Red Planet*, 208-209.; Markley, *Dying Planet*, 182-197.

been dreamed of on earth." [23] Driven by the conditions set by nature, Martian society had found peace and united its engineering genius to solve their greatest natural resource dilemma. The technocracies dreamed of by the Progressives seem to be echoing throughout this interpretation of Martian life.

If Martians were to view Earth from a similar standpoint, Lowell considered that humanity's mastery of the environment and technological triumphs would be sure signs of our intelligence. The regularity and efficient lines of the transcontinental railroads and the "methodical rectangles of the farms of the Great West" would be "the first signs of intelligence to one considering the earth from far."[24] Edward S. Morse, Lowell's most ardent adherent, expanded on this in his 1906 *Mars and its Mystery.*[25]

> If in the mind's eye we were to survey the Earth from Mars the only feature we should find at all paralleling the lines in Mars would be found in the level regions of the West, where, for thousands of miles, the land extends in vast level stretches. In these regions would be found lines of railroads running in straight courses, starting from definite places, converging to common centres, their sides, in certain seasons, conspicuous with ripening grain fields, or again the work of the United States Reclamation Bureau running its irrigating canals through that great region.[26]

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[23] Garrett P. Serviss, "The Tragedy of Life on Mars. That Planet, Which Seems to Have Reached Last Act in Drama of World-Life and Intelligence, Is Pitted against Inanimate Nature," *The Washington Post*, June 9, 1913.
[24] Lowell, *Mars and Its Canals*, 362-363.
[25] Lane, *Geographies of Mars Seeing and Knowing the Red Planet*, 162-166.; Markley, *Dying Planet*, 102-104.
[26] Edward S. Morse, *Mars and its Mystery* (Boston, MA: Little, Brown, and Company, 1906), 118.

These large-scale projects would evidently illustrate the enlightened and intelligent nature of humanity to Martian astronomers. Because of its arid and expansive nature, the American West was a perfect point of comparison for these two authors.[27]

The connections with earthly irrigation and Progressive politics were clearly conveyed by reporters. For example, in 1904, *The Arizona Republican* reported on Lowell's discoveries from his Flagstaff observatory. His discoveries were impressive and well substantiated, the reporter explained. And yet, the reporter lamented, "Mr. Lowell has been unable to determine so far, whether irrigation on the planet Mars is attended by any of the difficulties which have beset the industry in some parts of the West." Lowell could not inform the interested public whether Martians had resolved issues of "priority rights" or if they found it necessary to "form a water users' association in order to protect the interests of all concerned." Unsupplied by answers from Lowell, the reporter came to his own conclusions that were clearly influenced by the U. S. government's newly established role in western water politics and the general failure of the Carey Act (to be discussed below). "Presumably," the reporter deduced, "irrigation on Mars is done by the Martian government…the vast scale upon which the work has been carried out precludes the theory that private enterprise was sufficient for the task."[28]

Considered within the cultural context of the Progressive Era, it is no accident that Lowell's gaze was directed at the irrigation works of the enlightened Martians.[29] Percival Lowell used the natural death of the Earth as a reason for natural resource conservation at

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[27] Lane, *Geographies of Mars Seeing and Knowing the Red Planet*, 164.; Comparisons between Mars and the American West have also been featured prominently in science fiction. See: Carl Abbott, *Frontiers Past and Future: Science Fiction and the American West* (Lawrence, KS: University Press of Kansas, 2006).
[28] "An Arizona Discovery," *The Arizona Republican*, March 29, 1904.
[29] Lane, *Geographies of Mars Seeing and Knowing the Red Planet*, 175-185.

the State level because of the scale of the changes. The late nineteenth and early twentieth centuries witnessed the ascendancy of extreme technological faith directed at solving the increasingly evident water problems of the American West. As will be discussed below, the United States Reclamation Service, established in 1902, was the manifestation of the belief in mastering the arid western environment through state-controlled, large-scale feats of engineering. The Martian government and its engineers were to be respected for providing an object lesson in how best to proceed in manipulating the natural world and form a utopian society. The Martian canals in many ways reflected this hope and faith in environmental mastery through the State.[30] Lowell had recognized that the environment of Earth would push back through its inevitable course of desertification, but he considered humanity's domination of nature as necessary since "[a]s the brain develops, it must take possession of its world." In time, according to Lowell, "the earth will bear his imprint and his alone. What he chooses, will survive; what he pleases, will lapse, and the landscape itself become the carved object of his handiwork."[31] As was the case with the Martians, it was only natural that humanity would control the forces of nature through ingenious engineering.

By 1916, the year of Lowell's death, the connection between Martian and earthly irrigation projects continued to resonate. For example, in an editorial in *The New York Times*, the energy required to construct and operate the irrigation works on Mars became a source of debate. The author noted that an "anthracite engineer" believed that "Lowell's theory of irrigation canals on tangents was impossible, because there could not possibly

[30] For a study of how Mars has served as a screen for seeing Earth's ecology and the environmental sciences, see: Markley, *Dying Planet*.
[31] Lowell, *Mars as the Abode of Life*, 109-110.

be enough coal on Mars to pump the amount of water necessary to irrigate the area of the canals." "There are, however, two sources of power common to the Earth and Mars, inexhaustible and unlimited" the author countered, "the interior heat of the planet and the heat from the sun." Just because these sources were not used on Earth due to the "more economical sources available is no argument against their use on Mars."[32] Abundant energy, these men recognized, was vital to the project of reclamation and large-scale irrigation works.

Before the West could be reclaimed through force, the garden-West had to be resuscitated and backed by science, and then come face-to-face with the reality of the unrelenting cycles of aridity that characterized life beyond the hundredth meridian. By the mid-1890s, it was evident to most that rain did not follow the plow and that the West would not invite settlement without the aid of a little human ingenuity. The geologic Fall of the western lands was clear to many. It had revealed itself through the hardships faced by western settlers. For individuals like Lowell, Mars was a parable for the natural death that was about to befall Earth. Proof of this was in the data gathered in the West and conveyed by geologists like Dana that showed North America drying up. Therefore, the irrigation works modeled by the Martians were humanity's only option to delay the inevitable dewatering of the planet. In the context of the Progressive Era, answers came through state-sponsored science and engineering and the use of abundant fossil energies. But first, confidence in the productive capacity of the dehydrated western soils had to be demonstrated by irrigation advocates.

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[32] Nelson Blount, "Engineering on Mars. The Effects of Irrigation as Seen in a System of Canals," *New York Times*, February 5, 1916.

Watering the Garden Dream:
The Blessings of Aridity and the Latent Fertility of Western Soils

Irrigation was a practice long pondered and utilized in revitalizing the arid soils of the West. It was certainly not a new practice for farming in spite of scant rainfall. Since the days of Mesopotamia and Ancient Egypt, irrigation has been used to supplement the deficiencies of the sky.[33] The Mormons were one of the first successes in the story of western irrigation, and soon after the Civil War western explorers and surveyors recognized its potential for making the desert blossom.[34] The soil was understood to have all of the elements necessary for agriculture. All that was missing was enough water to make the desert blossom. The miracle of irrigation complimented the belief that rain follows the plow. If nature would not willingly submit to the advance of civilization, then humanity must remake their environment with their endowed powers of dominion over

[33] T. Douglas Price and Gary M. Feinman, *Images of the Past*, 4th ed. (Boston, MA: McGraw-Hill, 2005), 429-459.

[34] The Mormons will not be covered in detail in this analysis. However, they are a fascinating story of how religion and centralized control over irrigation worked to reclaim a particularly desert-like region of the West. Hazen explained their success as the product of "special causes, - religious fanaticism, a mild but forcible despotism, the industrious habits brought from Northern Europe, and the spur of a lucrative market, produced first by the emigration of 1849, then by military occupancy, and most of all by the discovery of the precious metals in the adjoining Territories."; General. W. B. Hazen, "The Great Middle Region of the United States, and Its Limited Space of Arable Land," *North American Review* CCXLVI, no. January (1875): 18.: For more information on the Mormons, see: Thomas G. Alexander, "Stewardship and Enterprise: The LDS Church and the Wasatch Oasis Environment, 1847-1930," *The Western Historical Quarterly* 25, no. 3 (1994): 341-364.; Thomas G. Alexander, "Irrigating the Mormon Heartland: The Operation of the Irrigation Companies in Wasatch Oasis Communities, 1847-1880," *Agricultural History* 76, no. 2 (2002).; Leonard J. Arrington and Dean May, ""A Different Mode of Life": Irrigation and Society in Nineteenth-Century Utah," *Agricultural History* 49, no. 1 (1975): 3-20.; Jared Farmer, *On Zion's Mount: Mormons, Indians, and the American Landscape* (Cambridge, MA.: Harvard University Press, 2008).; Dan L. Flores, "Zion in Eden: Phases of the Environmental History of Utah," *Environmental Review: ER* 7, no. 4 (1983): 325-344.; D. Michael Quinn, *The New Mormon History: Revisionist Essays on the Past* (Salt Lake City, UT: Signature Books, 1992).; Wallace Stegner, *Mormon Country* (New York: Duell, 1942).; William E. Smythe, *The Conquest of Arid America* (New York: Harper & Brothers Publishers, 1900), 51-76.

the natural world.[35] The drought that plagued the American West during the 1890s forced many to reconsider their faith in nature to see civilization coming and change its character to suit human settlement. As the population of the West expanded, the human costs of booster literature and ignoring signs of cyclical climactic patters became increasingly dramatic and caught the attention of the nation. Seeing that nature was not up to the task, they turned their faith to the technologies of irrigation.[36] The secret was in the western soils that contained all of the necessities of vibrant agriculture. This section will briefly examine Ferdinand Vandeveer Hayden's thoughts on irrigation, and then turn its focus to irrigation advocate William E. Smythe's vision for the West.

The productive capacity of the soils was known before irrigation became a national obsession. However, the overriding faith that the West be subject to a natural climactic shift made irrigation a lesser concern. For example, in 1872, Hayden remarked in the second USGS report that while "[e]ven the most enthusiastic of our companions in travel will not hesitate to pronounce it a desert," a two hundred mile "desolate" region of

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[35] For more examples of the hopeful potential for irrigation iin the West that repeatedly arose in Hayden's reports, see: Ferdinand Vandeveer Hayden, *Preliminary Report of the United States Geological Survey of Wyoming and Portions of Contiguous Territories (Washington: Government Printing Office, 1872),* 70, 114, 191, 194-195, 209, 452-453.; Ferdinand Vandeveer Hayden, *Preliminary Report of the United States Geological Survey of Montana, and Portions of Adjacent Territories; Being a Fifth Annual Report of Progress for the Year 1871* (U.S. Government Printing Office, 1872), 173, 201, 226, 258.; Ferdinand Vandeveer Hayden, *Sixth Annual Report of the United States Geological Survey of the Territories: Embracing Portions of Montana, Idaho, Wyoming, and Utah; Being a Report of Progress of the Explorations for the Year 1872* (U.S. Government Printing Office, 1873), 277-278.; Irrigation was also prominent in the booster literature he composed. For examples, see: Ferdinand Vandeveer Hayden, *The Great West: Its Attractions and Resources. Containing a Popular Description of the Marvellous Scenery, Physical Geography, Fossils, and Glaciers of This Wonderful Region; and the Recent Explorations in the Yellowstone Park, "The Wonderland of America," by Prof. F.V. Hayden, LL.D., Formerly United States Geologist. Also, Valuable Information to Travellers and Settlers Concerning Climate, Health, Mining, Husbandry, Education, the Indians, Mormonism, the Chinese; with the Homestead, Pre-Emption, Land, and Mining Laws. By a Corps of Able Contributors. Handsomely Illustrated with Engravings and Maps.* (Bloomington, IL: Charles R. Brodix, 1880), 84-85, 131, 293, 207, 213.

[36] George Wharton James, *Reclaiming the Arid West: The Story of the United States Reclamation Service* (New York: Dodd, Mead and Company, 1917), xv-xvi.

Wyoming could be rejuvenated through irrigation. The soil, Hayden stated, "possesses the elements of fertility." He had faith that human industry could release the latent energies of the soil. "If streams of water could be made to circulate through these broad, treeless, and almost plantless plains," Hayden submitted, "and the same amount of human industry employed as has been so remarkably exhibited by the Mormons in Salt Lake Valley, there is no doubt they would become productive." As discussed in the previous chapter, Hayden was of the mind that change would also happen naturally. He therefore put little thought into this prospect, and left exactly how this would be accomplished as "a question for the people of that future to determine."[37]

In that future, a couple of decades later, one of the greatest popular prophets of the "irrigation movement" William Ellsworth Smythe, offered an answer.[38] In 1891, he created the journal *Irrigation Age* and was at the helm of the national irrigation congress movement. The work of Smythe helped to provide the popular support needed to advance the reclamation movement that created the 1894 Carey Act and culminated in the 1902 Newlands Act (reclamation Acts that will be discussed below).[39] To advance the cause of irrigation, the first national irrigation congress was held in Salt Lake City, Utah, in September 1891, and Smythe was its chairman. It was not by accident that this was the location where the Mormons had illustrated the power of irrigation. The congress also

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[37] Hayden, *Preliminary Report of the United States Geological Survey of Wyoming*, 147.
[38] For more information on the "irrigation crusade," see: James Earl Sherow, *The Grasslands of the United States: An Environmental History*, Abc-Clio's Nature and Human Societies Series (Santa Barbara, CA: ABC-CLIO, 2007), 92-99.
[39] Lawrence B. Lee, "William Ellsworth Smythe and the Irrigation Movement: A Reconsideration," *Pacific Historical Review* 41, no. 3 (1972): 290-291, 307, 311.; Donald J. Pisani, *To Reclaim a Divided West: Water, Law, and Public Policy, 1848-1902* (Albuquerque, NM: University of New Mexico Press, 1992), 233-268.; On the dedication page of an early history of the United States Reclamation Service, Smythe was described as "The Eloquent and Convincing Orator, Who by pen and voice sought the education of the people."; James, *Reclaiming the Arid West: The Story of the United States Reclamation Service*, dedication.

was a step forward in relations between Mormons and other westerners since the past had been tinged with violence and prejudice. The situation was facilitated by the fact that the Mormon Church had just abolished the practice of polygamy that made many Americans uncomfortable.[40] This congress also became the site for the creation of the American Society of Irrigation Engineers.[41] Irrigation, Smythe believed, would make for small, intensely farmed family plots in the West and make the region densely populated and integrated into the national economy.[42] John Wesley Powell was less optimistic and considered western irrigation only a partial panacea. In 1893, Powell said as much and presented a challenge to Smythe at the Lost Angeles International Irrigation Congress. His defiance of the irrigation deity did not yield stark tensions between the two men, but rather the conversation continued in the pages of *Irrigation Age.* Ultimately, the debate helped to drum up press for the event and spread the gospel of irrigation across the nation.[43]

In Smythe's estimation, "[t]he application of man's energy and faith alone is necessary to produce in the western half of the continent the most perfect civilization the world has ever seen."[44] Early western settlers had been overly optimistic and deluded by the government. "They have fought through years of hardship;" Smythe recounted, "indulged in the delusive hope that the climate was about to change; bombarded the sky with explosives and wooed the clouds through the agency of mysterious chemicals and

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[40] Lee, "William Ellsworth Smythe and the Irrigation Movement: A Reconsideration," 293-294.
[41] Lee, "William Ellsworth Smythe and the Irrigation Movement: A Reconsideration," 296.
[42] Lee, "William Ellsworth Smythe and the Irrigation Movement: A Reconsideration," 301-302.
[43] Lee, "William Ellsworth Smythe and the Irrigation Movement: A Reconsideration," 303.; William E. Smythe, "The Progress of Western America," *The Irrigation Age* VI, no. 1 (1894): 4-5.
[44] Smythe, "The Progress of Western America," 1.

awe-inspiring machines with funnels." But their real hope was with "scientific irrigation, based on the utilization of such water supplies as nature has provided."[45]

Smythe's most famous publication was his 1900 *The Conquest of Arid America* where he summed up his sentiments on the revolutionary potential for irrigation and the wonders in store for the West. The West was, according to Smythe, "the better half of the United States." The region had awaited "riper time" and "a nobler impulse" to be peopled.[46] In order to fully appreciate the West, one had to live in it and experience its aridity.[47] Smythe credited Powell with reviving interest in the West as it had previously suffered under the weight of "many misrepresentations and strange misconceptions, which inevitably scattered wide the seeds of prejudice."[48] Aridity was a "blessing" because as history has shown it produced the benefits of great institutions through the cooperation required in a hostile environment, and as science had shown aridity had created rich soils where water is the only means of fertilization required for a bountiful harvest.[49] Smythe believed in the promises of socialism, but he also saw the cooperative nature of small-plot irrigation (averaging around 20 acres) as promoting democratic ideals while at the same time alleviating the alienation involved in large-plot western agriculture.[50] A community of irrigators would have to be led by an enlightened leader who ruled with his head and heart because Smythe saw that men were, at that juncture in

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[45] Smythe, "The Progress of Western America," 7.
[46] Smythe, *The Conquest of Arid America*, 19.
[47] Smythe, *The Conquest of Arid America*, 21-22.
[48] Smythe, *The Conquest of Arid America*, 24.
[49] Smythe, *The Conquest of Arid America*, 30-40.; This belief in the fertility of arid soils did not quickly dissapear and can be seen in the following publication.; James, *Reclaiming the Arid West: The Story of the United States Reclamation Service*, 25-27.
[50] Smythe, *The Conquest of Arid America*, 43, 45-46, 266, 300.; For more information on Smythe's democratic vision, see: Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West* (New York: Pantheon Books, 1987), 118-125.

history, inherently unequal in their abilities and resources.[51] A democratic and socialist paradise was on the horizon in the West, but it would take hard work to achieve.

Smythe reminded those familiar with the Bible that "the glories of the Garden of Eden itself, were the products of irrigation."[52] Nature had revealed her harsh western character and those who were swindled with the "theory that rainfall moved westward with population" or that "cultivation of the land wrought changes in climactic conditions" were faced with a "crushing and pathetic truth." What these ill-starred settlers discovered, Smythe understood, was "what could *not* be done in the semi-arid region."[53] But with irrigation, the West could absorb the "surplus population" of the United States, "millions of sturdy men and stout-hearted women to conquer the waste places and to work for themselves."[54] As late as the dawn of the twentieth century Smythe could claim that to even the most educated Americans the West was "a vague and mysterious quantity."[55] Yet, as we have seen, there was an abundance of booster material or as Smythe termed it "boom literature" from "railroads, land companies, and commercial organizations" available to mislead and provide "misinformation."[56] This mystery had to be overcome and in order to make successful settlements in the West one would have to bring "together surplus land, surplus labor, and surplus capital."[57] "Providence," decreed Smythe, "had provided a field for co-operative colonization, and then permitted it to lie

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[51] Smythe, *The Conquest of Arid America*, 285, 296-297.
[52] Smythe also quotes from an 1894 speech from Thomas B. Reed that speaks of irrigation that will make the "desert blossom" and "will bring forth the fruits of the Garden of Eden."; Smythe, *The Conquest of Arid America*, 42, 119.
[53] Smythe, *The Conquest of Arid America*, 107.
[54] Smythe, *The Conquest of Arid America*, 258.
[55] Smythe, *The Conquest of Arid America*, 254.
[56] Smythe, *The Conquest of Arid America*, 254.
[57] Smythe, *The Conquest of Arid America*, 260.

fallow until men should see the light."[58] It was "impossible" for settlers to fail under Smythe's irrigation plans.[59] With the proper application of capital and industrious settlers to surplus land one hundred million people could live in the West through "unlock[ing] the stores of wealth now imprisoned in the desert soil."[60] The capital required for such undertakings and the necessity for enlightened leadership over western irrigation set the conditions for the failures of the Carey Land Act and many projects executed under the Newlands Act.[61]

For Lowell, the dewatering of the West was a sign of things to come that would work to encourage humanity to join together for common survival. For Smythe and many irrigation advocates, the aridity of the West was what made the soils wondrously fertile and saved them for intelligent agriculturalists. The West's natural aridity was seen as both beneficial and permanent. In each of these visions, nature had to be coaxed into working for humanity. In this relationship change was seen to be directional rather than cyclical. This was not Hayden's nature. A verdant former environment would not naturally arise incidentally through the acts of civilization. It could, however, arise providentially through the application of enlightened irrigation.[62] The forward march of civilization would only progress through the power of the human mind paired with fossil fuels. The West was still malleable, but now it required scientific stewardship of the State and energy-intensive technological mastery to offer an agricultural abode for Americans.

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[58] Smythe, *The Conquest of Arid America*, 263.
[59] Smythe, *The Conquest of Arid America*, 264.
[60] Smythe, *The Conquest of Arid America*, 274-275.
[61] Smythe was not entirely enthused about either of these Acts as they were implemented. Each of them he criticized as compromising to his vision of irrigation's transformative potential. See: Lee, "William Ellsworth Smythe and the Irrigation Movement: A Reconsideration," 307, 310-311.
[62] By 1906 some were celebrating the "Mastery of the Desert." See: Frank W. Blackmar, "The Mastery of the Desert," *The North American Review* 182, no. 594 (1906): 676-688.

The Carey Act and Montana's Failed Irrigation Experiment

Many settlers were encouraged by theories of climate change, but it took until irrigation, reclamation, and dry farming were in vogue at the turn of the century for Montana to become considered an agricultural state.[63] After rain follows the plow faded into the background of settler dreams, Progressive Era plans to use fossil fuels and human engineering to wrestle the West into submission proceeded apace. They were often built on similar science, supported by the same hopes of human mastery over the environment, and underwritten with the scientific proof of a malleable West. The Montana homesteading boom was situated within the techno-science mastered West that was subsidized by the massive stores of fossilized energies embedded in the earth. Yet, even with all of this power, reclaiming the region would be a difficult task.

Before the Federal Government stepped into reclamation wholeheartedly, it took a step in the direction of State control. Swept in on the cresting wave of Smythe's irrigation mania, the Carey Land Act was passed in 1894 to supply arid western States with some means to reclaim land through irrigation. [64] Montana serves as a good example of attempts made to overcome the natural barriers that had subdued the western garden myth. Montana agricultural life really began in relation to the precious metal prospecting that was done in the middle of the nineteenth century, though it was relatively

[63] Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 52-53, 55-56, 66-70, 83-85.
[64] Lee, "William Ellsworth Smythe and the Irrigation Movement: A Reconsideration," 291, 294-297, 307.

insignificant.[65] This chapter will examine Montana's experience with the Carey Act and demonstrate the hopes and challenges that State-level irrigation inspired.

The 1894 Carey Act was the first step towards a rationalized, state-managed, system of irrigation to reclaim the arid West.[66] The Act's origins and seeds for failure can be seen in Powell's *Report*. Powell believed that well-financed and highly cooperative irrigation ventures would be the most successful in the West. To this end, he stated, "one condition should be imposed, namely, that the lands should be actually irrigated before the title is transferred to the purchaser. This method would provide for the redemption of these lands by irrigation through the employment of capital."[67] The spirit of this clause in Powell's *Report* made it into the provisions made in Montana for taking advantage of the Carey Act. The 1895 Montana Arid Land Act created the State Arid Land Grant Commission so that the state could use this federal reclamation legislation to irrigate parched parcels.[68] The Carey Act was an extension of the 1877 Desert Land Act that defined the geography of western "desert lands" and, as discussed in the previous chapter, amended the Homestead Act in these regions. The Act was "to aid the public land States in the reclamation of the desert lands therein, and the settlement, cultivation and sale thereof in small tracts to actual settlers."[69] It was believed that with the passage

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[65] Mary W. M. Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925* (Cambridge, MA: Harvard University Press, 1957), 28-29.
[66] For the history and examples of the failed implementation of the Carey Act, see: Pisani, *To Reclaim a Divided West*, 251-272.
[67] John Wesley Powell and Wallace Stegner, *The Arid Lands* (Lincoln, NE: University of Nebraska Press, 2004), 39.
[68] Lesley M. Heathcote, "The Montana Arid Land Grant Commission 1895-1903," *Agricultural History* 38, no. 2 (1964): 108.
[69] *Irrigation Law of the State of Montana, the Carey Act, Report of Arid Land Commission and Recommendations of Governor Smith Regarding Irrigation* (Helena, MT: State Publishing Company, State Printers and Binders, 1897), 3.

of this Act, "thousands of acres of the arid regions of the West will be reclaimed in the present year [1895]."[70] Each state defined within the "desert west" could receive up to one million acres of public land under this Act. However, in order to obtain this land the State had to ensure that the lands thus obtained were "irrigated, reclaimed, occupied, and not less than twenty acres of each one hundred and sixty acre tract cultivated by actual settlers, within ten years next after the passage of this Act."[71] Taking this a step further, even though it wanted lands to be settled as rapidly as possible, the state of Montana had no desire to be financially tied up in plans to reclaim land.[72] Under these conditions, the Commission was hard-pressed to find any reliable investors willing to wait the time required to successfully reclaim arid lands, obtain the title for the land from the Federal Government, *and then* find a buyer who would likely take a considerable amount of time to pay for the land.[73] Add to this the odd provision that a settler could not purchase more than 160 acres, which was not enough land to farm in the arid West, and you have conditions set for failure. This is an odd rule given the fact that the original Desert Land Act was created in response to this reality. The underlying assumption, it would seem, was that reclaimed land was just as good as the fertile garden soils that inspired the original Homestead Act.

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[70] "To Reclaim Arid Regions," *New York Times*, April 7, 1895.
[71] *Irrigation Law of the State of Montana*, 4.
[72] Heathcote, "The Montana Arid Land Grant Commission 1895-1903," 108.; Letter from John R. Foulks to the Secretary of the Board of State Arid Land Grant Commission, August 31, 1900. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 7. Montana Historical Society Research Center. Archives. Helena, Montana.; In this letter, the author explicitly stated that the reason for the Commission's failure thus far has been their inability to "bond the state" and the question was raised as to how it would be possible to reclaim lands without the direct financial support of the state of Montana.
[73] Heathcote, "The Montana Arid Land Grant Commission 1895-1903," 108.

Nonetheless, news of the day show that hopes remained high for the success of reclaiming Montana's arid lands and turning them into vibrant gardens. The Commission's Billings project was reported to "make one of the richest agricultural districts in Montana."[74] A man up for the position of engineer for the Commission claimed that canals were not necessary, and pipes were preferable. In 1897, he was quoted proclaiming, "To-day the rivers of Montana flow in the bottoms of the valleys and Montana is largely a pastoral and mineral state. Some day we will make the rivers flow along the hill tops, and then Montana will rank second to no state in its agricultural resources."[75] The reporter remarked that "[h]is plan has the daring of genius and it will either succeed gloriously or fail dismally." The engineer had the confidence of everybody in Helena, and if he were to succeed, he would "convert a wilderness into a paradise." All that he needed was "a Few Million Dollars or So to Put it Through."[76]

The Progressive Era was infused with a fossil-fueled faith in the human capacity to manipulate and engineer a better world. With plenty of cash, a rational mind, and the seemingly infinite reserves of energy embedded in the earth, humans could do anything. This philosophy was captured perfectly in 1901 in a Montana newspaper on the same page that news of the Commission was covered. In bold letters concluding the running section on "Town, County and State" news, the newspaper exclaimed "Energy will do anything that can be done in this world, and no talents, no circumstances, no opportunities, will make a two legged animal a man without it."[77]

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[74] "Irrigation in Montana," *New York Times*, October 15, 1897.
[75] "Over Hills and Dales," *The Anaconda Standard*, July 28, 1897.
[76] "Over Hills and Dales."
[77] "Town, County and State," *Fergus County Argus*, April 17, 1901.

In 1901, the opening of a canal in the Dearborn Valley (District 4 – 33,000 acres) met with positive press in California in a newspaper which reported that the canal "seems to be a good beginning in the solution of the great arid land problem." In the mood of the Progressive Era, it was also reported that the State would own and operate the canal system "in perpetuity for the sole benefit of the occupants…making the enterprise entirely cooperative in its nature." Furthermore, this was a milestone in reclaiming the West. "This is the first irrigating canal on the American continent to be built and operated by a State government," the paper reported, "and undoubtedly marks and epoch in irrigation progress."[78] In 1901, 11,000 acres of the 33,000 acres embraced by the Dearborn canal land was thought to have been irrigated and "ready for settlement" in 160 acre plots.[79] A Montana newspaper also reported that the enterprise was backed by "much money," and had "a large force of men at work" to complete the canal "without delay."[80]

The sad reality, however, was that the Dearborn canal was a certified failure. It began wrapped up in shady financial dealings that linked members of the Commission to the canal company contracted to construct the irrigation works. The press quoted above came from the 1901 celebration staged in early October to celebrate the supposed completion of 11,000 acres of the canal. The truth was that the land was not ready for settlement and that by 1903 no settlers were able to secure title to the celebrated lands.

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[78] "Will Irrigate Many Thousands of Acres," *San Francisco Chronicle*, October 12, 1901.; "Celebrates Canal Opening," *The Omaha Daily Bee*, October 12, 1901.; "Water Flows on Arid Land," *The San Francisco Call*, October 12, 1901.; See also; "Great Arid Land Problem," *The Free Press*, October 15, 1901.
[79] "Great Arid Land Problem."
[80] "Town, County and State."

Furthermore, the bookkeeping for the Dearborn canal was suspect and the contractor received over triple of what was estimated as the total value of the work performed on the project.[81]

Regardless of these realities, hopes remained high for the Dearborn canal and the other projects of the Commission. Paris Gibson, Montana pioneer and newly appointed U. S. Senator from Montana, wrote to a member of the Commission to inform them of his absence at the early October celebration at the Dearborn canal. In spite of his absence, Gibson wished to assure the Commission that he was "deeply interested in this enterprise, and will do all I can to aid in the settlement of the country covered by the Dearborn Canal." He thanked the Commission for contributing to the "advancement of our state" and he spoke to the passenger agent of the Great Northern Railroad, Frank Whitney, "to impress upon him the importance of furnishing a colony of first-class settlers for the Dearborn country."[82] Thomas C. Marshall, a Missoula, Montana, lawyer and Chairman of the Commission, likewise held hope that the Commission "will realize every anticipation and that the reclamation of the lands will be a decided success and furnish homes for many families, so that the once arid valley of the Dearborn and Sun River may in the near future be teeming with the multitudinous hum of an industrious community."[83] The president of Big Timber National Bank was also enthusiastic about Montana's reclaimed future. Writing to the Commission, he observed, "[i]f the poor d----

[81] Heathcote, "The Montana Arid Land Grant Commission 1895-1903," 116-117.
[82] Letter from Paris Gibson to Donald Bradford, October 2, 1901. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 8. Montana Historical Society Research Center. Archives. Helena, Montana.
[83] Letter from Thomas C. Marshall to David A. Cory, November 15, 1901. Montana State Arid Land Grant Commission Records. RS 31. Box 1, Folder 5. Montana Historical Society Research Center. Archives. Helena, Montana.

ls down in the drought stricken regions only knew of this land of milk and honey, no doubt they would be anxious to treck out to Montana. This is certainly a great state, and with the same amount of labor, best results can be secured."[84] The Commission sought to accomplish the "peopling of the now wild lands with an industrious population, and the consequent addition to the wealth of the whole State" with the help of "local patriotism."[85]

In order to secure settlers for their reclamation projects, the Commission advertised for immigration to Montana and the creation of colonies on irrigated lands.[86] For example, an 1899 letter from a prospective settler contained a clipping from *The Stock Growers Journal of Miles City* that carried a small story from the *Helena Independent*. The clipping stated that the Commission was looking for "anyone desiring to join a colony of farmers," and that "the commission will undertake to select a tract of land and build the necessary water system to irrigate it." The inquiring individual was interested in "the location of desirable land that would suit a person of limited means" or

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[84] Letter from J. A. Hall to C.O. Reed, July 23, 1901. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 9. Montana Historical Society Research Center. Archives. Helena, Montana.
[85] Letter from the State Arid Land Grant Commission to Mr. Hall and Ashbury, Bankers, Big Timber, MT, August 18, 1898. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 9. Montana Historical Society Research Center. Archives. Helena, Montana.
[86] Irrigation colonies were advanced by promoters like William E. Smythe. In an 1895 *New York Times* article concerning the Carey Act, William E. Smythe's Plymouth colony (named after the "ancient Massachusetts colony") in Idaho was mentioned as a prime example of eastern capital in the creation of a cooperative irrigation colony in the West. It would serve as "an object lesson in the reclamation of arid lands." The very same colony was referred to in correspondence between the editor of *The Irrigation Age* and the Montana State Arid Land Grant Commission in 1897. Also, the Salvation Army launched two western irrigation-base colonies in 1898 in order to uplift the "worthy poor."; "To Reclaim Arid Regions."; Smythe, *The Conquest of Arid America*, 191-196.; Pisani, *To Reclaim a Divided West*, 81-82.; Lee, "William Ellsworth Smythe and the Irrigation Movement: A Reconsideration," 308-310.; Letter from George E. Girling to the State Arid Land Commission, May 12, 1897. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 25. Montana Historical Society Research Center. Archives. Helena, Montana.; For information on the nature and problems of irrigation colonies, see: Pisani, *To Reclaim a Divided West*, 77-85.

if he could join a future colony of settlers. He was hopeful and ended his letter by explaining that he "thoroughly believe[d] in a future for the person who gets a reasonable start on his own account in Montana."[87] Another example comes from a farmer who wished to obtain information concerning when a canal would be completed so that he could plan his planting and invite "a number of families to settle under this ditch from Wisconsin that are all good farmers."[88] The cost of irrigated lands was on the minds of migrants and one man wrote to the Commission stating that he wanted "to come to Montana and homestead if the lands and the Irrigation are not to high till a poor man cann reach them."[89]

Settlers interested in irrigated plots also coveted Native American Reservation lands. During the 1880s and 1890s rumors were mounting about a large cession of the Crow Reservation for the purpose of irrigation and settlement by non-Natives. This was during the period of allotment following the 1887 Dawes Severalty Act and was ten years prior to the final reduction of the Crow Reservation that occurred in 1904. Writing to the Commission in 1894, a Wisconsin man desired to know more about the "lands in Mont (Crow Res) to be irrigated + open for settlement" so that he could obtain 160 acres.[90] The

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[87] Letter from Edward L. Fleming to Thomas C. Marshall, March 30, 1899. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 7. Montana Historical Society Research Center. Archives. Helena, Montana.

[88] Letter from Frank Banderob to David A. Cory, September 27, 1899. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 1. Montana Historical Society Research Center. Archives. Helena, Montana.

[89] Letter from Philip M Gregg to Donald Bradford, May 31, 1900. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 1897-1903, F-G Transcription. Montana Historical Society Research Center. Archives. Helena, Montana.

[90] Letter from M.D. Bryce to Donald Bradford, May 19, 1894. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 1. Montana Historical Society Research Center. Archives. Helena, Montana.; There was also interest in reclaiming Blackfeet land. Under the Carey Act interest in irrigating the Milk River region in northern Montana was given new hope. As will be discussed later, this project would turn into a significant project for the newly formed Reclamation Service formed under the 1902

correspondence of the Montana Arid Land Grant Commission shows that there was considerable interest in the work of irrigating lands in the state for the purpose of settlement on 160 acre plots.

Failure was more the forte of the Commission than fulfilling hopes for irrigating Montana into an Eden for emigrants. Many eagerly sought the Crow lands, and some considered the Commission to be an impotent imposition on Montana's land, which could get in the way of rapid and profitable settlement. A Billings-based hardware company owner believed that it would be great if the Commission could handle irrigating the ceded Crow lands since they would be able to "place the lands ceded from the reservation under a much more thorough and broader system of irrigation than can be undertaken by individuals." Yet, he doubted it was probable since he saw the Commission struggling and stated that they had "thus far failed to accomplish anything." The Commission would get in the way of "a thrifty class of farmers" if they "tied up" the land as they attempted and failed to execute a successful project on the Crow lands.[91]

The railroads in Montana were also hesitant to place their full faith in the work of the Commission. The Northern Pacific Railroad acknowledged the worth of the

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Reclamation Act. The president of the Great Northern Railroad was particularly interested in the future of this project because it lay in close proximity to his line. Series of correspondence during the years of 1893, 1894 and 1895 between James Hill and Paris Gibson concerning the Blackfeet lands and the nature of the Carey Act as it related to Montana. The correspondence also speaks to the problems of finding willing investors in these irrigation adventures, but the great potential of northern Montana for irrigation-based agriculture. However, Hill saw many of the farmers in the Milk River valley as lazy and unproductive. Document set 2104; 132.E.7.5.B; Great Northern Railway Company Records. Minnesota Historical Society.: There was also continued hope to have the entire Blackfeet Reservation opened into the early twentieth century: Letter from Paris Gibson to James J. Hill, January 31, 1906. James J. Hill Papers, 20.D.4.4. Minnesota Historical Society.; For information on what happened with the Blackfeet irrigation project once it came into the hands of the Reclamation Service, see: James, *Reclaiming the Arid West: The Story of the United States Reclamation Service*, 367-373.

[91] Letter from A. L. Babcock to D. A. Cory, August 21, 1899. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 1. Montana Historical Society Research Center. Archives. Helena, Montana.

Commission's potential success and provided passes for Commission members to travel along their line.[92] The Northern Pacific even collaborated with the Commission in enticing settlers to Montana. Settlers were to be vetted by the Commission and those believed to be "bona fide intending settlers" would receive "half rate transportation."[93] Nonetheless, the Northern Pacific was reluctant to become partners with the Commission in reclaiming arid lands.[94] The other Montana transcontinental railroad, the Great Northern Railway, was even more disinclined to partner with the Commission. When asked if the Commission members could receive railroad passes the Great Northern replied in the negative and encouraged the members to apply for passes per trip.[95] The Vice Chairman of the Commission responded that doing so would "prove an imposition upon you [the Great Northern Railway], and not to have passage free will prove quite a burden to this commission." The Vice Chairman could not conceive of the unwillingness of the railroad since the work of the Commission would clearly be of benefit to the railroad since they were hoping to "operate largely along the line" and were "devoting

[92] Letter from Thomas C. Marshall to C. F. Mellen, January 13, 1899. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 20. Montana Historical Society Research Center. Archives. Helena, Montana.; Letter from C. O. Reed to D. A. Cory, July 6, 1899. Montana State Arid Land Grant Commission Records. RS 31. Box 1, Folder 4. Montana Historical Society Research Center. Archives. Helena, Montana.; Heathcote, "The Montana Arid Land Grant Commission 1895-1903," 109.
[93] Letter from J. W. Kendrick to Donald Bradford, December 9, 1898. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 20. Montana Historical Society Research Center. Archives. Helena, Montana.
[94] Letter from Field Commissioner to O. R. Holcomb, January 4, 1899. Montana State Arid Land Grant Commission Records. RS 31. Box 3, Folder 3. Montana Historical Society Research Center. Archives. Helena, Montana.; Heathcote, "The Montana Arid Land Grant Commission 1895-1903," 112.
[95] Letter from D. Miller to Donald Bradford, February 14, 1899. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 1897-1903, F-G Transcription. Montana Historical Society Research Center. Archives. Helena, Montana.; "The Montana Arid Land Grant Commission 1895-1903," 109.

our time practically without pay in order that the state may be developed."[96] The Great Northern Railway was also unenthusiastic about collaborating with the Commission in settling the region.[97] Besides the government, the railroads were the largest landholders in the West and their hesitance to work with the Commission was a clear indication of its inadequacies. Without the railroads, the Commission was further handicapped in achieving their ambitious objective in reclaiming Montana's arid lands.

Reading through the Montana State Arid Land Grant Commission records at the Montana State Historical Society one gets a sense of the chaos and disarray that characterized the limited life of the Commission. Adequate capital and investment in their irrigation projects was consistently a problem. As Powell and many irrigation advocates knew, reclaiming arid lands required a lot of time and money. The problems that plagued the Commission illustrated that in order to pull off an irrigation scheme of scale in the West, one had to have the power and long-range investment apparatus of the State. Capitalism was not adequately up to the task. Furthermore, when large investors did get involved in such ventures the entire dream and purpose of the Homestead Act disappeared.[98] Powell himself, who warned of the need for cooperative irrigation arrangements, was accused of reigning over western development like an emperor even though he had no desire to play that role.

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[96] Letter from Donald Bradford to D. Miller, February 17, 1899. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 1897-1903, F-G Transcription. Montana Historical Society Research Center. Archives. Helena, Montana.

[97] Letter from Henry Semple Ames to D. A. Cory, May 14, 1900. Montana State Arid Land Grant Commission Records. RS 31. Box 2, Folder 15. Montana Historical Society Research Center. Archives. Helena, Montana.

[98] For a forceful examination of the negative social and environmental effects of water development in the West, see: Worster, *Rivers of Empire.*

Even those directly involved in the process of getting projects off of the ground were not optimistic. In 1897, for example, Montana's governor expressed concerns about the future of the state's irrigation and reclamation work. "Something must be done to remedy and correct the errors made in the legislation [1895 Montana Arid Land Act]," Governor Smith pleaded, "looking to the real reclamation of our Arid Lands."[99] Also, by 1901, it became clear that the Commission needed to have the lands assessed properly by a disinterested party. Correspondence between to Commission members in March of 1901 revealed that "[t]he most that is now lacking is the opinion of some reputable disinterested Civil Engineer."[100] Also, they recognized that investors understood that the government engineer's assessment was worthless since he had "never been on the ground, his source of information being largely topographical, and not hydrographical."[101] They would have to employ a reputable engineer to properly assess the land in order to obtain adequate investor confidence. This would add cost to their already modest budget.

Even worse, when on the ground, in June of 1901, one of the Commissioners was not convinced that one of their five primary projects was worth their time. Writing to his colleague, the Commissioner informed him that "a very considerable acreage segregated…is worthless," and some portions were "wholly valueless." He was unable to "see how these lands can be classified and sold without a survey, and where is the money

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[99] *Irrigation Law of the State of Montana, the Carey Act, Report of Arid Land Commission and Recommendations of Governor Smith Regarding Irrigation*, 26.
[100] Letter from C. O. Reed to D. A. Cory, March 4, 1901. Montana State Arid Land Grant Commission Records. RS 31. Box 1, Folder 5. Montana Historical Society Research Center. Archives. Helena, Montana.
[101] Letter from C. O. Reed to D. A. Cory, May 6, 1901. Montana State Arid Land Grant Commission Records. RS 31. Box 1, Folder 5. Montana Historical Society Research Center. Archives. Helena, Montana.

to come from. It is certainly a dark picture." "Bad management," he concluded, "bad, bad, bad, bad."[102] And, according to a civil and mining engineer inspecting the Dearborn Canal discussed above, the canal was faced with poor local opinion and under the threat of vandalism.[103] As a first attempt at State-run reclamation, the Commission was a letdown to locals and hopeful emigrants. Lessons were learned, but as one historian has put it, "the work of the Arid Land Grant Commission was a complete fiasco."[104]

Federal Reclamation and Buffalo Bill Cody

The transition from the Carey Act to the Newlands Act of 1902 (from State to Federal control over reclamation) is can be viewed through the wild water adventures of the famed Buffalo Bill Cody in Wyoming.[105] He had the power, money, and the influence to get things done in the West and as a consequence Cody was one of the few success stories of the Carey Act. Unlike Montana, the state of Wyoming played a positive role in pushing irrigation forward and supporting the Carey Act.[106] Now that it had extended a line to Cody's town, the railroad also had an interest in the realization of Buffalo Bill's vision.[107] Cody's partial success spearheading the creation of this town in the arid West was due to these two sources of support and his driving determination and belief that the

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[102] Letter from C. O. Reed to D. A. Cory, June 13, 1901. Montana State Arid Land Grant Commission Records. RS 31. Box 1, Folder 5. Montana Historical Society Research Center. Archives. Helena, Montana.
[103] Letter from George T. Wickes to D. A. Cory, September 17, 1902. Montana State Arid Land Grant Commission Records. RS 31. Box 1, Folder 6. Montana Historical Society Research Center. Archives. Helena, Montana.
[104] Heathcote, "The Montana Arid Land Grant Commission 1895-1903," 117.
[105] Interestingly enough, while employed as a scout for the military in 1868, Cody was once in the employ of the champion of aridity William Babcock Hazen.; Edward S. Cooper, *William Babcock Hazen: The Best Hated Man* (Madison, NJ: Fairleigh Dickinson University Press, 2005), 173-174.
[106] Robert E. Bonner, "Buffalo Bill Cody and Wyoming Water Politics," *The Western Historical Quarterly* 33, no. 4 (2002). 436-437.
[107] Bonner, "Buffalo Bill Cody and Wyoming Water Politics," 439.

region's geologically-based natural wealth was all that was needed for the region to prosper. This section will cover Cody's geologically informed project site, the rise of Federal Reclamation, the faith in reclamation to perform miracles of geologic agency, and the problems that plagued this hubris.

Cody's choice for locating his project in the Big Horn Basin had much to do with the deep past of the region. As we have seen, visions of reclaiming the West had a lot to do with its geologic history. For Cody, his deep understanding of the Big Horn Basin came from the geological education he received from his friend and former employer, the famed paleontologist O. C. Marsh. During the spring of 1901, a newspaper article circulated regaling the public with Cody's life as an Army scout and "the Rise and Fall of the Romantic Period on the Plains."[108] In this article, Cody explained how he became acquainted with the Big Horn Basin and its deep past. "Even in the thick of the Indian fighting," Cody explained, "it was impossible for a man to escape seeing the great possibilities of those arid States."[109] But seeing the West's potential with his own eyes was not enough for Cody, "it took a professor to convince me [Cody] of the chances of civilizing that country." It was during the Yale College Expedition, discussed in Chapter 6, that Cody was educated on the geologic past of the West. Cody remembered:

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[108] The source of the article seems to be the Boston Daily Herald and an intriguing variation occurred in a Minnesota newspaper. Instead of relating the carving of the Big Horn Basin to a former lake, the article credits the canyon's formation to a snake. The article stated, "[h]e said that the Great Big Horn basin was formed by the passage of a big snake that had finally cut its way through the Big Horn canon." This could very well be a typo or a transcription error, but it is crucial to note that this article would have been seen by a number of people who admired Buffalo Bill and had an interest in the exploits of fossil hunters like O. C. Marsh. The snake story is also reminiscent of the Native American fossil explanations described in Chapter 5. What those who read this account thought about the deep past and how ancient animals and environments affected the nature of the West may not be possible to know for certain. However, it is evident that the deep past played a decided role in how people considered the present condition of the region.; "Col. W. F. Cody, Tales of Early Days in the West.," *The Cook County Herald*, July 13, 1901.

[109] PENDENNIS, "Colonel William F. Cody Tells of His Life in the West as an Army Scout," *The St. Louis Republic*, May 5, 1901.

> Well! I got kinder jealous of that professor. He was always talkin' a whole lot of stuff about that country that I'd never heard before. He said that the Great Big Horn basin was formed by the passage of a big lake that had finally cut its way through the Big Horn canyon. He went on to tell why there should be in this basin the finest soil in the world; that there must be great mineral deposits there, probably sea gold, because the lake had been salt water. I said to him then that I guess he thought he knew more about that country than I did, and told him he'd better go it alone.[110]

Cody was not fond of being told by this eastern scientist that he was ignorant of the real nature of the West. Nevertheless, he absorbed this geological information and used it to inform his future land speculation and irrigation venture. Eventually, he would come to believe that "the old fossil hunter was right" and the region abounded in natural resources, grazing land, and fertile agricultural soils to raise cereals.[111] This bountiful Eden was built upon visions of its geologic past.

And so, using the transformative power of industrialized irrigation and the natural wealth of the former seascape soils, Cody built a town that now bears his name. In the above article, Cody credited the Carey Act with enabling him to organize the Shoshone Land and Irrigation Company with his son-in-law Horton Boal and George T. Beck.[112] With a government concession of 200,000 acres through the Act, they built "a canal and got settlers." Soon after, on July 4, 1900, the Burlington railroad made its way to the town of Cody which by that time was 640 acres and had a "population of 5,000 people in two years."[113] Smythe commented in *The Conquest of Arid America* that Cody used

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[110] PENDENNIS, "Colonel William F. Cody Tells of His Life in the West as an Army Scout."
[111] PENDENNIS, "Colonel William F. Cody Tells of His Life in the West as an Army Scout."
[112] For more information on how Cody's business venture developed, see: Bonner, "Buffalo Bill Cody and Wyoming Water Politics."
[113] PENDENNIS, "Colonel William F. Cody Tells of His Life in the West as an Army Scout."

"[t]he money which the public had poured into the coffers of his Wild West Show…in reclaiming and colonizing two hundred thousand acres."[114] Like Cody, Smythe held high hopes for the Big Horn Basin. "In time," he heralded, "the region must acquire a large population and support a many-sided industrial life."[115] Cody's irrigated paradise would be a beacon in the West for settlers seeking lands endowed with special potential by nature and finished by the human hand.[116]

The reality was less sanguine than Cody submitted. Creating the canal was a challenging and expensive feat and the company could not make a profit. As Smythe commented, Cody often had to fund the Shoshone Land and Irrigation Company's projects with the profits from his Wild West Show.[117] Furthermore, Cody did not find it easy to get settlers to his town and to successfully get water to settlers. [118] By 1902, Cody's dream did not require his presence to be put into action. This transition is somewhat symbolic in that the future of the West was taken from the hands of the man who represented its most powerful mythologies and romantic past and placed into the hands of a technocratic arm of the Federal Government which looked to remove

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[114] Smythe, *The Conquest of Arid America*, 213.
[115] Smythe, *The Conquest of Arid America*, 214.
[116] Cody's romantic vision of the West even infiltrated the river that would help to irrigate his lands. The State Engineer Elwood Mead renamed the river from Stinking Water to Shoshone when the project began. In a sense, they were reclaiming the name of the river before they performed the technical irrigation work.; Bonner, "Buffalo Bill Cody and Wyoming Water Politics," 434.
[117] Pisani, *To Reclaim a Divided West*, 258.
[118] Bonner, "Buffalo Bill Cody and Wyoming Water Politics," 435.; Cody's experience under the Carey Act is also covered in the following: Pisani, *To Reclaim a Divided West*, 254-260.; Robert Bonner, *William F. Cody's Wyoming Empire: The Buffalo Bill Nobody Knows* (Norman, OK: University of Oklahoma Press, 2007).

romanticism and replace it with rational planning and scientific settlement. Gone were the days of the cowboy, here were the days of the engineer.[119]

Fossil-fueled industrialization had brought the modern State to bear on the West to overcome fears of scarcity and restore faith in abundance.[120] The passage of the Newlands Act gave the State and the railroad another avenue to accomplish their reclamation and settlement goals.[121] The Newlands Act of 1902, also known as the Reclamation Act, represented high hopes of keeping alive the agrarian dreams of the Homestead Act through technology and the technocratic vision of the State.[122] The democratic dreams of Smythe were alive and well in this Act and contemporaries credited the Reclamation Service with promoting democracy through assisting the masses through "irrigation works of gigantic magnitude."[123] The Service was an "Army of Peace" which a 1917 popular history described as turning the "once arid West" into a garden.[124]

Under this Act, a large section of Cody's Wyoming venture was coopted by the Federal Government. With the passing of the Reclamation Act, Cody sold a portion of his

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[119] The Reclamation Serivce was a technocratic body consisting of a structured system of engineering expertise that culminated with the "chief engineer" who had total control over a project. See: F.H. Newell, *Third Annual Report of the Reclamation Service, 1903-4* Second Edition, Department of the Interior, United States Geological Survey (Washington: Government Printing Office, 1905), 39-41.

[120] For an exploration of the West's tendency to oscillate between scarcity and abundance, see: William Cronon, "Landscapes of Abundance and Scarcity," in Clyde A. Milner II, Carol A. O'Connor, and Martha A. Sandweiss eds., *The Oxford History of the American West* (New York: Oxford University Press, 1994), 603-637.

[121] Bonner, "Buffalo Bill Cody and Wyoming Water Politics," 439-451.; Louis S. Warren, *Buffalo Bill's America: William Cody and the Wild West Show* (New York: Alfred A. Knopf, 2005), 482-493.

[122] For a great bibliography of the history of reclamation, see: United States Bureau of Reclamation, "Readings in the History of the Bureau of Reclamation," Department of the Interior, Reclamation: Managing Water in the West (2011).; For an early history of the Bureau of Reclamation and its projects, see: James, *Reclaiming the Arid West: The Story of the United States Reclamation Service*.

[123] James, *Reclaiming the Arid West: The Story of the United States Reclamation Service*, xii.

[124] James, *Reclaiming the Arid West: The Story of the United States Reclamation Service*, xx-xxii.

reclamation plot to the government who by 1910, under the Reclamation Service, completed construction on the 328-foot Buffalo Bill Dam (initially called the Shoshone Dam) that put a halt to the natural flow of the Shoshone River.[125] The project cost around $26 million, seven lives, and irrigated around 93,000 acres of farmland ($279.57 per acre!).[126]

A 1910 *New York Times* article celebrating the opening of the dam perfectly conveys the culture and mythology of American reclamation. It begins with the strong statement that, "[t]here are times when nature absolutely fails to deliver the goods." This was where the might of the human hand came in. "The completion of the Shoshone Dam in Wyoming – the highest water barrier made of masonry in the world – calls to mind another occasion," the reporter reflected, "when the hands of the gods always seemed to be waiting for the 6 o'clock whistle to blow."[127] Humans were here to complete nature's work in the West. Indeed humans were to alter the natural order and amend the actions that occurred through millions of years of geologic time to create the canyon through which the Shoshone River ran. "Perhaps the Shoshone," speculated the reporter, "would never have undertaken the job if it had known that Mr. Roosevelt was coming." Men were put to work to undo what Mother Nature had taken millions of years to accomplish and went forth "wrestling the liberty from just such romping, carefree streams as the

[125] Pisani, *To Reclaim a Divided West*, 259.; Newell, *Third Annual Report of the Reclamation Service*, 626.
[126] Pisani, *To Reclaim a Divided West*, 259.; "Buffalo Bill Dam History," Buffalo Bill Dam Visitor Center, accessed May 10, 2014, http://www.bbdvc.com/Buffalo_Bill_Dam_History.html.; The initial cost per acre for settlers was $46: Bonner, "Buffalo Bill Cody and Wyoming Water Politics," 445.; The cost estimates of the dam as represented in the press were "a little more than half a million dollars" to reclaim "132,000 lost acres."; "A New Wonder of Irrigation in the West." *New York Times*, February 6, 1910.
[127] "A New Wonder of Irrigation in the West."

Shoshone."[128] The dam was projected to be so successful in redeeming the desert land that it would threaten eastern farmers. The land, before reclamation, "was as burned as a bride's biscuit." As soon as the dam was put to work, "[t]he desert began to bloom."[129] The farmers in the region would no longer fall victim to the capriciousness of western weather. The dam could be credited with defying the climactic problems previously cited as the primary problem of settling the West. The reporter confidently declared, "the Shoshone Dam makes the farmers roundabout independent of the clouds, so far as rain for their crops is concerned."[130] The condition of Mars and the natural course of planetary dewatering and death once again came to the fore in this article. "Thus, when water becomes scarce on the earth," the reporter explained, "as it is now on Mars, future Americans can employ themselves by lining their canals with concrete."[131] The West, through its geologic past, had become a symbol for the dying earth and society's need to organize and cooperate for survival [Figure 55].

The Act, however, suffered mightily from embedded contradictions, compromises, and an overconfidence in the human ability to change the arid character of

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[128] The 1917 history of the Reclamation Service by George Wharton James likewise described the damming of the Shoshone as restoring what had been the previous state of the land in geologic time. After describing the geologic process of the river cutting through the canyon, Wharton stated, "[w]hen civilized man came upon the scene science and skill were called upon by imagination which said: 'Build a gigantic dam in that gorge, and restore to the face of nature the exquisite lake that, centuries ago, she lost.'"; James, *Reclaiming the Arid West: The Story of the United States Reclamation Service*, 355.

[129] "A New Wonder of Irrigation in the West."

[130] Even with these confident pronouncements, the reporter did not necessarily advocate for easterners emigrating to the West. The article ends by stating the absurdity of seeking land in the West when farms in New York can be found for less cost and with less uncertainty concerning future prospects for crops. Ultimately, however, the question of quality land and the future of agriculture was up to finding good farmers to till the earth.; "A New Wonder of Irrigation in the West."

[131] "A New Wonder of Irrigation in the West."

the West.[132] The Reclamation Act was the paradoxical product of the fossil-fueled and expert-driven Progressive Era social climate of the United States and the long-held belief that America was an agricultural nation.[133] Mastery is the handmaiden of stewardship. Geoengineering and reclamation are just different forms of conservation. The Reclamation Act created the Reclamation Service (renamed the Bureau of Reclamation in 1923) that used massive amounts of energy to create the many hydroelectric and irrigation water projects that dot the arid West. In this final push to keep the dream of an Edenic West alive, the Federal Government utilized industrial might through its two powerful arms, the Reclamation Service and the Army Corps of Engineers, to make the region bend to human hopes. Historian of western water politics Marc Reisner summed up the philosophy of the those individuals working in the service of the Reclamation Act as follows: "The engineers who staffed the Reclamation Service tended to view themselves as a godlike class performing hydrologic miracles for grateful simpletons who were content to sit in the desert and raise fruit."[134] They represented an unquestioning faith in the power of technology that was inherent in the philosophy of reclamation in the arid West. This philosophy was also powered by the visions and energy of the paleo-past. Under similar logic as that of Smythe concerning the natural fertility of arid soils, many

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[132] Pisani, *To Reclaim a Divided West*, 273-325.; Charles F. Wilkinson, *Crossing the Next Meridian: Land, Water, and the Future of the West* (Washington, DC: Island Press, 1992), 246-259.

[133] For how reclamation fits into the Progressive Era, see: Samuel P. Hays, *Conservation and the Gospel of Efficiency: The Progressive Conservation Movement, 1890-1920* (Pittsburgh, PA: University of Pittsburgh Press, 1999), 12-16, 242-252.; Donald C. Jackson, "Engineering in the Progressive Era: A New Look at Frederick Haynes Newell and the U.S. Reclamation Service," *Technology and Culture* 34, no. 3 (1993): 539-574.

[134] Marc Reisner, *Cadillac Desert: The American West and Its Disappearing Water* (New York: Penguin Books, 1993), 114.

of the soils on top of which reclamation projects rested were assumed to be fertile and were left untested for years.[135]

Cody's project was built on the idea that the West's geologic history had produced a rich agricultural environment that could be reclaimed through irrigation. After running up against some difficulties, the Federal Government entered in and put tremendous energy behind this vision. The power of the Reclamation Service was so great that some considered it as a force of nature on par with the geological processes that had shaped the earth. Left in their wake were a series of environmental and social catastrophes resulting from the firm conviction that the West was malleable.[136]

Montana's Milk River and Federal Reclamation

Montana also engaged in this high-powered push for dominance over nature through the Milk River Reclamation project. The history of energy in the West underlies the history of water.[137] This reclamation scheme serves as a prime example of the social and environmental brute force exercised by the fossil-fueled Reclamation Service.

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[135] Donald J. Pisani, "Federal Reclamation and the American West in the Twentieth Century," *Agricultural History* 77, no. 3 (2003): 396.

[136] Wilkinson, *Crossing the Next Meridian*, 259-274.; Stephen Grace, *Dam Nation: How Water Shaped the West and Will Determine Its Future* (Guilford, CT: Globe Pequot Press, 2012).; James Lawrence Powell, *Dead Pool: Lake Powell, Global Warming, and the Future of Water in the West* (Berkeley, CA: University of California Press, 2008).; Reisner, *Cadillac Desert.*; Worster, *Rivers of Empire*.: Pisani notes an important fact that counters the heavy-handed attacks leveled at the Bureau of Reclamation advanced by Reisner and Worster. It was not simply the Bureau acting singlehandedly, but rather the public had a considerable amount of say in the work of reclaiming the West.; Pisani, "Federal Reclamation and the American West in the Twentieth Century," 418-419.

[137] There is a general absence of energy discussions in histories of water in the West. Hydroelectricity is often mentioned in these texts, but the amount of fossil fuels that went into constructing and maintaining these facilities is rarely, if ever, examined. Reclamation is tied to energy in at least two ways. The first is that it took a lot of fossil fuels to create the colossal reclamation projects that now dot the West. From the concrete used to build dams to the fuel needed to move massive amounts of earth. The second tie is that the dams created to reclaim the West were multipurpose. They were to control the unrestrained energies of the waterways of the West in order to reduce flood danger and to channel those energies into hydroelectric power for use by industrial America.

Through the Milk River Reclamation Project, this section will further demonstrate the Reclamation Service's believe in geological mastery, the enormous scope of these reclamation projects, the social impacts and opposition to reclamation, and its negative effects on the natural world.

The idea for the Milk River Irrigation project has roots in 1891 when diverting water from St. Mary River to the Milk River was suggested. However, it was not until 1902, with the passage of the Reclamation Act, that it would become one of the first five projects authorized by the newly formed Reclamation Service. The problem to be solved by the Service, like many of their other projects, was to make an otherwise irregular and unruly river useful for farming regardless of nature's climactic variations.[138] As one historian of the Reclamation Service saw it, the engineers sought to "repair the damages" done by the prior ice age and restore "to the plains' streams the headwaters which in past geologic ages probably belonged to them." While it would be expensive, this would be an easy task for the engineer.[139] With the passage of the Reclamation Act new phrases and perspectives came to be used concerning the arid West. No better example than referring to the Milk River region as holding "many thousand acres of excellent arid land."[140] The arid nature of the West was once again considered a virtue rather than a curse.[141] Whereas Zebulon Montgomery Pike saw the arid West as a useful barrier against invaders and to restrain the wandering impulses of Americans, the region was now seen

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[138] Fredric L. Quivik, "Overcoming Barriers: Milk River Irrigation Project, Montana, USA," *Engineering History and Heritage* 164, no. EH4 (2011): 245-248.
[139] James, *Reclaiming the Arid West: The Story of the United States Reclamation Service,* 178.
[140] Newell, *Third Annual Report of the Reclamation Service,* 80.
[141] Beyond what has already been mentioned on this account, see the following for another example of the belief that the aridity of the West was in fact what made the region great and full of promise.; James, *Reclaiming the Arid West: The Story of the United States Reclamation Service,* 23.

as an agricultural frontier for expanding Progressive America. Aridity was an asset to the garden of America.

The Milk River project was, however, plagued with a number of "difficulties" from its beginning. There were delays in executing the project because the Milk River was not solely America's river, part of it flowed into Canada and Fort Belknap Reservation held a significant portion of the irrigable land. Furthermore the Reclamation Service had to deal with the fact that private landowners held some of the required lands, and some of the Great Northern Railroad's tracks lay in the way of the plans.[142] The chief obstacle was that the river flowed into Canada and then back into the United States which meant that a treaty had to be agreed upon in order to begin work in earnest on the project.[143] The Boundary Waters Treaty was signed on January 1, 1909, and the work of reclaiming the arid nature of northern Montana began.[144]

Canada was not the only nation that the United States had to reconcile relations with in order to execute their Milk River plans. Reclamation followed on the coattails of reductions in tribal lands and continued Native American dispossession. It worked as another tool of dispossession that followed up on actions taken under the Dawes Act. The purpose of the Act was to make Native Americans agriculturalists and therefore civilized citizens and to reduce tribal land holdings and open them up for settlement by non-Native Americans. A number of irrigation projects were built upon recently ceded lands because the Federal Government only had to deal with an already subject population rather than

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[142] Newell, *Third Annual Report of the Reclamation Service*, 291-307.
[143] Quivik, "Overcoming Barriers: Milk River Irrigation Project, Montana, USA," 248.
[144] William Joe Simonds, "Milk River Project," Department of the Interior: Bureau of Reclamation (1998), 3-8.

ranchers or American agriculturalists who had previously settled the land. Also, the land on which many of the Reservations sat was understood to be suboptimal at the time when the reservations were created.[145] With the rise of the Reclamation Service these subprime lands could be reclaimed from nature and from the hands of Native Americans. As soon as irrigation was offered as a potential opportunity for transforming these lands, settlers and the transcontinental railroads quickly made plans to obtain any ceded lands.[146]

Native Americans (Gros Ventre and Assiniboine) on the Fort Belknap Reservation in the Milk River region protested the water diversion involved in the reclamation project. The protests made their way to the Supreme Court and with the 1908 legal decision *Winters v. United States* it was recognized that they were to be provided with adequate water on the reservations, but this had little effect on how the project was shaped. Furthermore, the legal decision was largely ignored and did not in practice secure

[145] This is similar to Smythe's commentary about the fact that prejudice and mystery of the arid West was fortuitous because it forced many to await proper irrigation science and enabled a rational settlement pattern in the West. The Indian Removal Act of 1830 referred to in Chapter 1 was an illustration of one of the first legislative actions to place Native Americans on what was considered suboptimal agricultural land (considered desert land to many).

[146] See above references to the Crow reservation during the period of the Montana State Arid Land Grant Commission. See also: Megan Benson, "The Fight for Crow Water: Part I, the Early Reservation Years through the Indian New Deal," *Montana: The Magazine of Western History* 57, no. 4 (2007).; Newell, *Third Annual Report of the Reclamation Service,* 83-85, 326-336.; The following early history of the Reclamation Service has a chapter on "Improving Conditions for the First Families of America. Projects for the Indians" in which the Reclamation Service worked with the Indian Service to "encourage active and practical agriculture among their wards.": James, *Reclaiming the Arid West: The Story of the United States Reclamation Service,* 366-386.; The Northern Pacific and Great Northern railroads were also very interested in this land and used it in their promotional materials. A number of railroad promotional materials were put out at the start of the twentieth century illustrating the potential for irrigation and settlement on ceded reservation lands. These advertisements described the hidden potential for fertile agricultural land through irrigation and the abundant coal resources that could be found in close proximity to homestead plots. For example, see: "Opportunities for Homesteaders on the Fort Peck Reservation, 1915," 132.6.8.6.F; Great Northern Railway Company Records. Minnesota Historical Society.; "1906 Booklet Advertising for Settlement on the Flathead Reservation." 132.6.8.6.F; Great Northern Railway Company Records. Minnesota Historical Society.; Northern Pacific Railroad Company, "Irrigation in Montana," 1905, PAM 3566, Montana Historical Society Research Center.; Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 364-372.

water rights for the Native Americans of Fort Belknap.[147] The *Winters* decision was founded upon the premise that motivated Smythe's belief in irrigation's capacity to better society and the dreams that underwrote the Homestead Act. The powerful vision of an agricultural Republic informed how to "civilize" Native Americans, and in the twentieth-century arid West this meant using the transformative power of irrigation. The idea was to encourage the Fort Belknap Native Americans to abandon a semi-nomadic life and adopt the life of agriculturalists.[148] Furthermore, Native Americans were regularly put to work on reclamation projects and were evaluated, in at least one case, as to how well they compared to an "ordinary gang of white labourers." For example, Blackfeet work on irrigation projects in northern Montana was thought to function as another method of "civilizing" and increasing Native American "efficiency."[149] The social mimicked the natural character of the West in that they were both malleable. All that it would take was enlightened irrigation.[150]

Not all American citizens praised the gospel of reclamation. The Native Americans of Fort Belknap were not the only Americans upset by the Reclamation Service's Milk River project. In 1912, the president of the Great Northern Railway Company, Louis W. Hill, wrote to the Secretary to the President, Charles D. Hilles concerning homesteader complaints about the Reclamation Service. Hill had visited a

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[147] Norris Hundley Jr., "The 'Winters' Decision and Indian Water Rights: A Mystery Reexamined," *The Western Historical Quarterly* 13, no. 1 (1982): 267-270; Dan A. Tarlock, "Tribal Justice and Property Rights: The Evolution of *Winters V. United States*," *Natural Resources Journal* 50 (Spring 2010): 471-199.; Wilkinson, *Crossing the Next Meridian.*; Simonds, "Milk River Project," 8-11.
[148] Tarlock, "Tribal Justice and Property Rights: The Evolution of *Winters V. United States*," 477-478.
[149] James, *Reclaiming the Arid West: The Story of the United States Reclamation Service*, 370-372.
[150] For another example of the relationship between Native Americans, their land, and reclamation, see: Robert B. Campbell, "Newlands, Old Lands: Native American Labor, Agrarian Ideology, and the Progressive-Era State in the Making of the Newlands Reclamation Project, 1902–1926," *Pacific Historical Review* 71, no. 2 (2002): 203-238.

county fair in Glasgow, Montana, and was "told by homesteaders that the Reclamation Service had withdrawn about twenty sections north of Bowdoin Lake and were paying a man sixty dollars a month to keep settlers from ranging stock on this grass land."[151] This was a misappropriation of government funds according to Hill, and was "antagonizing all the people in the district." Hill continued his attack on the work of the Reclamation Service:

> Certainly stock eating this grass could not injure it for reclamation purposes, if the Reclamation Department ever intend using it, which is very doubtful in everyone's mind. It is little things of this kind that antagonize the West against the Departments in Washington. The Reclamation Department are not only proving themselves of little practical benefit to our portion of the West, but they seem to take every means of antagonizing the settlers.[152]

The Milk River region, in Hill's eyes, was being mistreated by the federal work of reclamation. Due to the difficulties detailed above, the Milk River project must have seemed to many settlers an impossible undertaking. Hill told Hilles that he could "site you an endless number of similar cases" where the Reclamation Service had angered westerners. Hill also noted that he was aware of a Reclamation Service engineer that was simultaneously employed by the Union Pacific Railroad in order to help them settle the

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[151] Letter from Louis W. Hill to Charles D. Hilles, September 13, 1912. 132.E.20.9.B; Great Northern Railway Company Records. Minnesota Historical Society.; Louis Hill's defense of these settlers is interesting considering his father's earlier attack on the people of the Milk River region as lazy. In 1895, James Hill stated, "[t]he people who are now in the Milk River Valley have not shown a disposition to be useful to the country, but seem rather to desire to make a living without working for it. We have not much interest in people of that class.": Letter from James Hill to Charles Hall, January 10, 1895. 132.E.7.5.B. Great Northern Railway Company Records. Minnesota Historical Society.

[152] Letter from Louis W. Hill to Charles D. Hilles, September 13, 1912. 132.E.20.9.B; Great Northern Railway Company Records. Minnesota Historical Society.

country along their lines. “These are the things the people do not like,” Hill dutifully concluded, “and I don’t blame them.”[153]

The gargantuan reclamation projects executed by the Reclamation Service and later Bureau of Reclamation were necessarily responsive to environmental conditions but were also characterized by a philosophy of mastery over the natural world. Historian of technology Fredric Quivik emphasized that this was not a brute force technological approach, but rather the Service had to deal with and surmount the inconsistencies presented to them by nature.[154] However, all engineering projects must concede to natural laws on some level. The philosophies that motivated the project were inspired by a firm belief in the human capacity to alter the natural world. The irrigation works constructed by the Service were built using fossil-fueled technologies that used incredible amounts of energy to manipulate nature to human desires to dominate the arid West. The engineers of the Reclamation Service did not submit to the will of nature and abandon the project. They adapted to challenges because they had faith in their mastery and dominion over the natural world. As stubborn as Mother Nature could be, there was no question that she could be outwitted and manipulated. The Earth continued to be malleable regardless of moments of obstinacy. The Milk River project was in fact what one would call “brute

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[153] The acting Secretary to the President Carmi A. Thompson replied to Hill to answer his charges and stated that the lands were needed for a reservoir and the grazing lands for hay. Thompson explained that grazing leases were offered and “no bids were received” and that “officials of the Reclamation Service are instructed to at all times exercise the utmost patience and tact in dealing with settlers.” Thompson also answered to the charges regarding the engineer employed by the Union Pacific.; Letter from Carmi A. Thompson to Louis W. Hill, September 25, 1913. 132.E.20.9.B; Great Northern Railway Company Records. Minnesota Historical Society.; The Hill family had at this point began a period of poor relations with the Reclamation Service and had begun to see that settlers were not happy with many of their projects. See: Claire Strom, *Profiting from the Plains: The Great Northern Railway and Corporate Development of the American West* (Seattle, WA: University of Washington Press, 2003), 94-102, 140-144, 155.

[154] Quivik, “Overcoming Barriers: Milk River Irrigation Project, Montana, USA,” 253.

force" technology, as Paul Josephson has defined it, which "have significant and irreversible environmental and social consequences."[155] The Milk River region was also an "Industrial Eden" where the garden-West could, through progressive technologies and Providence, be revived and Americans could play out their agricultural designs and reclaim the Fallen western desert waste through the human hand and the energies of modernism.[156] The narrative of dominance over the natural world was pervasive in the Progressive Era and was encouraged by the everyday visible changes brought about through science and technology.[157]

The Reclamation Service used the power of steam, diesel, and Native American labor to move massive amounts of earth (80,000 cubic yards in the year 1907 by the Native American teams alone). The project took almost four decades to finish (1946), eventually provided irrigation for around 120,000 acres, served as a successful measure of flood control, and was sporadically and sometimes unsuccessfully settled throughout

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[155] Paul R. Josephson, *Industrialized Nature: Brute Force Technology and the Transformation of the Natural World* (Washington, DC: Island Press/Shearwater Books, 2002), 12-13.

[156] The term "Industrial Eden" comes from the work of Mark Fiege. See: Mark Fiege, *Irrigated Eden: The Making of an Agricultural Landscape in the American West* (Seattle, WA: University of Washington Press, 1999), 171-202.; Historian of technology David E. Nye also included western irrigation of arid lands as a "technological creation story" whereby "[t]he land was regarded as empty space waiting for the white man to develop its latent potential. Settlers arrived and transformed the land using a new technology that made possible the foundation of new communities…Irrigation seemed to exemplify the idea of a man-made second nature." In the case of Federal Reclamation, the homesteader became dependent on the government to survive in the arid West.; David E. Nye, *America as Second Creation: Technology and Narratives of New Beginnings* (Cambridge, MA: MIT Press, 2003), 207, 211, 239-241.

[157] For more information on the historical lineage of the dominance narrative, see: Carolyn Merchant, *The Death of Nature: Women, Ecology, and the Scientific Revolution* (New York: Harper & Row, 1989).; Carolyn Merchant, *Reinventing Eden: The Fate of Nature in Western Culture* (New York: Routledge, 2003).; Nye, *America as Second Creation*.; Lynn White, "The Historical Roots of Our Ecologic Crisis," *Science* 155, no. 3767 (1967): 1203-1207.; Aldo Leopold refered to it as the "Abrahamic concept of land."; Aldo Leopold and Charles Walsh Schwartz, *A Sand County Almanac. With Other Essays on Conservation from Round River* (New York: Oxford University Press, 1986), xviii-xix.

its history.[158] Some amendments were made to the project up until the late 1960s and when everything was said and done the Milk River Project was the "largest Reclamation project in Montana."[159] It consisted of "three storage reservoirs, five diversion dams, 200 miles of canals, 219 miles of laterals, and 294 miles of drains."[160] This endeavor could never have been accomplished without abundant sources of energy and the firm conviction that the West could be remade.

Above were some examples of the social consequences, but the environment also suffered alongside the human residents of the region. The dams constructed throughout the West by the Bureau of Reclamation, as Marc Reisner rightly pointed out, "made it close to impossible for numerous native species to survive."[161] By creating such large technological structures that sought to control nature through "high modernist" philosophies, the reclamation unleashed a host of "normal accidents" upon the West.[162] Furthermore, the intense resource requirements and environmental impact of concrete production are now being fully realized in the context of global climate change.[163]

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[158] Simonds, "Milk River Project," 11-25.; The high point for farms was in 1960 when there were 724 farms located on the project.

[159] Bureau of Reclamation, "Montana, Bureau of Reclamation Projects," Department of the Interior (Washington, DC: 1983), 5.

[160] "Montana, Bureau of Reclamation Projects," 5; "Milk River Project: Montana, Blaine, Glaier, Philips, and Valley Counties / Upper Missouri Region, Bureau of Reclamation," Department of the Interior (Washington, DC: 1983).

[161] Reisner, *Cadillac Desert*, 511.

[162] Marshall Berman, *All That Is Solid Melts into Air: The Experience of Modernity* (New York: Simon and Schuster, 1982).; David Harvey, *Justice, Nature, and the Geography of Difference* (Cambridge, MA: Blackwell Publishers, 1996), 184-185.; Charles Perrow, *Normal Accidents: Living with High-Risk Technologies* (Princeton, NJ: Princeton University Press, 1999).; James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press, 1998).

[163] The dominant construction material for these reclamation projects was concrete. The Buffalo Bill Dam required 82,900 cubic yards of concrete. As can be seen in James' history of Federal Reclamation, the Milk River project relied on concrete as a construction material. Concrete production is extremely energy intensive and is a major emitter of carbon dioxide into the atmosphere.; "Buffalo Bill Dam History," Buffalo Bill Dam Visitor Center, accessed May 10, 2014,

The Milk River Reclamation Project demonstrated that the conceit that humans can control nature and remake the West is only true in part. As the project was being executed, it was assumed that the Reclamation Service was fixing the damage done by geological processes. These engineers saw themselves as geological agents as America's grip on the natural world tightened with the explosive use of fossil fuels. However, as is often the problem, the tighter the grip the more that slips through one's fingers. Furthermore, not everyone who wanted to garden in the West fit into regions rationalized by the Bureau of Reclamation. Nor did everyone want to be rationalized. Thus, the project brought social and environmental consequences to bear on the Milk River region. Yet, there remained another ray of hope for western agriculturalists. If engineering and technology could not save the garden dream, then perhaps science could solve agricultural practice and make the desert blossom.

Dry Farming: The Progressive Era's Scientific Solution to the Great American Desert

Reclamation and dry farming represented the culmination of the previous one hundred years of reconciling the natural condition of the West (desert or garden) with the human capacity to change nature. They were solutions to the settlement problems of the

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http://www.bbdvc.com/Buffalo_Bill_Dam_History.html.; James, *Reclaiming the Arid West: The Story of the United States Reclamation Service*, 183-184.; Dan Barbor, Diana Plian and Loredana Judele, "Environmental Impact of Concrete," *Buletinul Institutului Politehnic Din Iaşi* Tomul LV (LIX), Fasc. 4, 2009 Sectia Construcţii. Ărhitectură. 27-35.; United States Environmental Protection Agency, "Cement Manufacturing Enforcement Initiative," EPA Website, accessed January 14, 2015, http://www2.epa.gov/enforcement/cement-manufacturing-enforcement-initiative#emissions.; Vaclav Smil, *Energy in Nature and Society: General Energetics of Complex Systems* (Cambridge, MA: The MIT Press, 2008), 281-282.

arid West that typified the Progressive Era.[164] They also contained within them the belief in a malleable Earth that arose from discoveries of geologic history's material relics. The seeds were sown for geoengineering and purposeful manipulation of natural systems such as climate. Faith in the adaptable, technology-wielding hominid was triumphant. These attempts at engineering a more fertile agricultural West were products of what could be found in the earth. Fossils and fossil fuels lent credence to elevating humans beyond natural systems and into a god-like position where we could tinker with the Earth to make it a more comfortable home. They were both scientific material objects and cultural artifacts that spoke beyond the realm of science and into America's national mythology. This section will focus on the transition from reclamation to dry farming as the use of science rather than technology in making the arid frontier conform to agricultural dreams. Through the experiences of James J. Hill and the dry farming science of Hardy Webster Campbell, this section will demonstrate the continued faith in an agricultural West and the scientific lineage of dry farming.

Dry farming brought swarms of homesteaders to the West.[165] The early twentieth century, when dry farming was popular, saw the largest number of homestead patents in American history.[166] Contemporaries and historians into the mid-twentieth century celebrated dry farming as an amazing innovation in conquering the Great American

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[164] Gary D. Libecap and Zeynep Kocabiyik Hansen, ""Rain Follows the Plow" and Dryfarming Doctrine: The Climate Information Problem and Homestead Failure in the Upper Great Plains, 1890-1925," *The Journal of Economic History* 62, no. 1 (2002): 96-97.
[165] Michael Malone, Richard B. Roeder, and William L. Lang, *Montana: A History of Two Centuries* (Seattle, WA: University of Washington Press, 1976), 183.
[166] Wilkinson, *Crossing the Next Meridian*, 247-248.

Desert.[167] The largest technological system of the West, the transcontinental railroads, exploited the fossil fuel wealth of the region and continued to advance images of a malleable West. James J. Hill and the Great Northern Railway used reclamation and dry farming as Progressive Era technoscientific methods to manipulate the plastic West. Hill was a firm believer in the agricultural potential of the West and drove hard to make that vision come to fruition.[168] America was "pre-eminently and primarily an agricultural country" according to Hill.[169] He considered himself as largely responsible for the passage of the Reclamation Act and saw that it would help breathe life into his hopes for a West dotted with family farms.[170] Through his earlier experiences with irrigation in the Milk River region, Hill came to the conclusion that attempting reclamation in the West was not the province of the private sector, it required the far reaching power of the State.[171] Hill was also pragmatic and realized that any program to facilitate settlement in the West would yield dividends for him in terms of traffic on his lines and the peddling of land owned by the railroad.[172]

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[167] For example, two famous western historians Walter Prescott Webb and Henry Nash Smith regarded dry farming as a sufficient solution to the arid lands problem. Webb stated, "It must not be thought that dry farming is a panacea for the ills of the arid Great Plains. It is the practice that promises to enable the farmers (provided they have enough suitable land and enough intelligence and industry) to achieve some success in regions where irrigation is impossible or impracticable." Smith stated, "[n]ot until special seeds were developed and special methods of cultivation devised – the techniques of 'dry farming' – was agriculture feasible on a large scale beyond the one hundredth meridian."; Walter Prescott Webb, *The Great Plains* (Boston, MA: Ginn, 1959), 373.; Henry Nash Smith, *Virgin Land: The American West as Symbol and Myth* (New York: Vintage Books, 1950), 201.

[168] Claire Strom, "James J. Hill: Empire Builder as Farmer," *Minnesota History* 54, no. 6 (1995): 242-253.; Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 75-76.

[169] James Jerome Hill, *Highways of Progress* (New York: Doubleday, Page & Company, 1910), 15.

[170] Pisani, *To Reclaim a Divided West*, 288.; Hill, *Highways of Progress*, 189.; Strom, *Profiting from the Plains*, 66-74.

[171] Strom, *Profiting from the Plains*, 58.

[172] Hill, *Highways of Progress*, 206-207.; Michael P. Malone, *James J. Hill: Empire Builder of the Northwest* (Norman, OK: University of Oklahoma Press, 1996), 252-253.; Pisani, *To Reclaim a Divided West*, 289-290.

Hill believed that "Man must adapt the distribution of water, by which the earth's productiveness is regulated, to suit his needs."[173] Through "one of the most beneficent works ever carried out by any government for its people," reclamation had eliminated the Great American Desert.[174] Yet even though the desert had disappeared from the imagination, once again we hear a familiar story about the amazing nature of arid landscapes. The desert-like conditions were real, but they were actually a benefit to the western agriculturalist. That was where the myth of the Great American Desert lay. It was not in the desert's infertility through aridity, but rather in how the desert was perceived as a barrier and an uninhabitable region. "Abundance follows," Hill explained, "because reclaimed lands are richer than any others in the elements that promote growth."[175] He was echoing what had become conventional wisdom regarding the area once avoided due to its wasteland character. Having been born on a farm in Ontario, Hill was passionate about agriculture and believed that agricultural settlement in the West could cure a number of social ills that were cropping up at the start of the twentieth century.[176]

Reclamation's cousin was dry farming. Hill held on to hope for its success in turning the desert into a garden as well.[177] His attention was diverted to dry farming in large part because of the delays experienced in the Milk River Project. Hill began to lose

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[173] Hill, *Highways of Progress*, 185.
[174] Hill, *Highways of Progress*, 191, 198.
[175] Hill, *Highways of Progress*, 201.
[176] Hill, *Highways of Progress*, 45.; Malone, *James J. Hill*, 193-198.; Strom, "James J. Hill: Empire Builder as Farmer," 244.
[177] Hill, *Highways of Progress*, 199.; However, Hill had hoped to rebrand the practice by removing the word "dry" because he saw it as a negative descriptor and essentially bad publicity. See: Malone, Roeder, an Lang, *Montana: A History of Two Centuries*, 184-185.; Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 108-110.; "Delegates Want Dry Farming to Have New Name," *Los Angeles Herald*, October 27, 1909.: Paris Gibson was also a promoter of dry farming. See: Richard B. Roeder, "A Settlement on the Plains: Paris Gibson and the Building of Great Falls," *Montana: The Magazine of Western History* 42, no. 4 (1992): 13.

faith in the Federal Government's plans and sought alternative ways to profit from his western land holdings.[178] Dry farming came into being as an alternative way to market the agricultural potential of the West as the failures of reclamation were increasingly evident.[179] Historian of dry farming Mary Hargreaves defined the practice "as agriculture without irrigation in regions of scanty precipitation."[180] The goal was to use science in order to adapt agricultural practices to the arid West. This technique represented the belief that the West may not be malleable. Paradoxically, humanity had to change in response to the western environment in order to master it. And yet, the success of the dry farming doctrine in part lay in the cyclical patterns of wet seasons. There was a period of wet weather that characterized the testing and the application of dry farming by settlers from 1909-1918.[181]

Dry farming was the product of the lineage of previous theories of the malleable West as they came up against the hard realities of the region during a period of scientific and technological optimism. The work of Hardy Webster Campbell, arguably the most well-known advocate of scientifically-informed dry farming in the West, showed elements of previous agricultural theories.[182] He believed that through his methods the

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[178] Strom, *Profiting from the Plains*, 74, 77, 90.; Hill was not alone in using dry farming as a promotional method for his lines. See: Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 224-241.
[179] Malone, Roeder, and Lang, *Montana: A History of Two Centuries*, 181.; Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 23.; W. Eugene Hollon, *The Great American Desert Then and Now* (Lincoln, NE: University of Nebraska Press, 1975), 151-159.; Charles R. Kutzleb, "Rain Follows the Plow: The History of an Idea" (Boulder, CO: University of Colorado, 1968), 369-373.
[180] Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 3.
[181] Malone, *James J. Hill*, 252.; Malone, Roeder, and Lang, *Montana: A History of Two Centuries*, 186.; Libecap and Hansen, ""Rain Follows the Plow" and Dryfarming Doctrine," 89, 98.; Gerald Davidson et al., "Gleanings from H-West: Rain Follows the Plow," *Montana: The Magazine of Western History* 49, no. 4 (1999): 93.
[182] Malone, Roeder, and Lang, *Montana: A History of Two Centuries*, 181.; According to Hargreaves, the techniques of dry farming were already being practiced before Campbell came on to the national stage. The major innovation at the turn of the twentieth century was the amount of promotion put into this farming

West would be dominated by millions of small family farms because, "[t]he small farmer has given character to agriculture everywhere and at all times."[183] Campbell claimed that by taking advantage of the "unexplainable" "natural law…called capillary attraction" through the "deep plowing" of the land and intensive agriculture, farmers would be able to retain the moisture of the land.[184] This theory was very similar to the science that informed the work of Samuel Aughey and the popularizing work of Charles Dana Wilber that breathed life into "Rain Follows the Plow."[185] The arid earth would naturally become a sponge as soon as civilization plowed forth its promise. Illustrating Campbell's acceptance of the arid character of the West, the cover of his 1907 manual cleverly stated "The Camel for the Sahara Desert; The Campbell Method for the American Desert" [Figure 56]. [186] He assumed that the soil of the arid West was "admirably adapted to the best farming," and contrary to what skeptics have said the very dryness of the atmosphere "is of great advantage" to the farmer. Those who took Campbell's advice would find that "[t]he key has been found and the door to the riches has been unlocked."[187] Campbell also held on to a belief similar to Hayden's regarding the climactic impact of

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method in order to increase settlement in the West. The promotion was primarily accomplished by the railroads, bankers, merchants, grain men, and public institutions. See: Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 83-125, 220-221, 223-275, 541.

[183] Hardy Webster Campbell, *Campbell's Soil Culture Manual* (Holdrege, NE: H.W. Campbell, 1902), 5, 7, 101.; Hardy Webster Campbell, *Campbell's 1907 Soil Culture Manual: A Complete Guide to Scientific Agriculture as Adapted to the Semi-Arid Regions* (Lincoln, NE: The Campbell Soil Culture Co. (Inc.), 1907), 28-31.; His success in advocating such a settlement pattern for the West in large part was because Campbell believed in small family plots that alligned well with the Homestead Act ideal. This was far different from the huge plots envisioned by Powell and many irrigation advocates.; Libecap and Hansen, ""Rain Follows the Plow" and Dryfarming Doctrine," 97-98.

[184] Malone, Roeder, and Lang, *Montana: A History of Two Centuries*, 182.; Mary W. M. Hargreaves, "The Dry-Farming Movement in Retrospect," *Agricultural History* 51, no. 1 (1977): 153-154.; Campbell, *Campbell's Soil Culture Manual*, 6, 15-16.; *Campbell's 1907 Soil Culture Manual*.; Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 21.

[185] See the discussion of Aughey and Wilber in the previous chapter.

[186] Campbell, *Campbell's 1907 Soil Culture Manual*.

[187] Campbell, *Campbell's 1907 Soil Culture Manual*, 33, 36, 135.

arboriculture or tree planting in the West. He considered there to be "truthfulness" in the theory the belief "asserted by scientists that the growing of trees on the bare prairies will increase rainfall."[188] Campbell's scientific understanding of the nature of the West was undoubtedly infused with the theories that preceded his attempt to master the region.[189]

However, like Hazen's critique of the Northern Pacific Railroad's boosting efforts, references to the geological history of the West are generally absent from dry farming literature. Campbell's only reference to geology is to remark that the soil of the West "is, in fact, a part of the volcanic matter which composes most of the earth."[190] The reason for this seems to be that the practice of dry farming is built upon the premise that the West is in fact arid and will stay arid into the future. In fact, its aridity was central to why dry farming would be successful. If the West were to change climactically, the doctrine of dry farming would be dismissed as just plain farming. Especially given the fact that its adherents claimed that dry farming would work anywhere, there would be nothing special about it as a practice if there were no arid spaces to dominate. This negative evidence serves to illustrate that climate change theories rely on geologic history to provide proof of a dynamic earth. It also suggests that nature's own malleability was less a factor in considering how the region would change. Humanity's power was now far more significant.

The socio-political climate of Campbell's day was the height of the Progressive Era and as a consequence the appeal to science was vital to the popular success of his

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[188] Campbell, *Campbell's Soil Culture Manual*, 11.
[189] Historian Mary Hargreaves has noted that uncertainties about the public need and the environment underlay the dry farming movement and that its "genesis lay deep in the background of the nineteenth century."; Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 24, 540-541.
[190] Campbell, *Campbell's 1907 Soil Culture Manual*, 104.

method.[191] According to Campbell, "the more perfect adaptation of scientific methods to farming would result in doubling the crops in the great semi-arid belt of America."[192] But in this "age of progress" characterized by "miracles in industrial and commercial life" it would take "applying the genius of man" and "intelligent and progressive farmers of the great west" to make the desert blossom.[193] Even if the science was faulty and based on an incomplete understanding of agriculture in the West, there were no other strong alternatives that arose to challenge the scientific authority of the dry farming propaganda.[194] Dry farming rested upon the scientific authority and technological power that were products of the use of fossil energy and on the persistent dream of realizing a garden-West that was given momentum and strength from those fossil fuels and images of the deep past that evidenced a malleable earth.[195] For a nation intent on expansion and on retaining the ideal of the yeoman farmer it was fortuitous that such a technique was found since it drastically expanded acres available for the nation's agriculture.[196] Its partial agricultural success was borne from the nutrient bounty of the soils built up over millennia and a cycle of wet weather in the West.[197]

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[191] Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 90.; Libecap and Hansen, ""Rain Follows the Plow" and Dryfarming Doctrine," 96.
[192] Campbell, *Campbell's 1907 Soil Culture Manual*, 7.
[193] Campbell, *Campbell's 1907 Soil Culture Manual*, 8, 13, 14.
[194] Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 226-328, 543-546.
[195] A great example of how far technofaith and a firm faith in the potential for science and fossil fuels to transform and enhance agriculture is the massive Montana farm created by Thomas D. Campbell in 1918. It was such a huge and "high modernist" venture that James C. Scott used the farm as an example of the *hubris* involved in thinking as Campbell did that "farming was about 90 percent engineering and only 10 percent agriculture." Vital to Campbell's operation were "large gasoline engines" that enabled his limited workforce to cover an extensive section of agricultural land in a relatively small amount of time.; Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 508.; Scott, *Seeing Like a State*, 197-198.
[196] Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 19.
[197] Libecap and Hansen, ""Rain Follows the Plow" and Dryfarming Doctrine," 103, 105.

Dry farming arose out of the persistent dream of performing agriculture in the garden-West. Campbell's science was constructed from many of the previous theories favoring a plastic world. Unbeknownst to him, the evidence he used was built from the cyclical climate of the region and that the soils in fact did have some latent productive capacity stored for setters to use.[198] Nature, hope, and scientific authority conspired to make dry farming an attractive option for agriculturalists. Men like James J. Hill held on to the garden-West as the answer for problems encountered in industrial society. Furthermore, for Hill and his railroad, it was profitable to believe Campbell's gospel.

Montana's Homesteading Boom and Agricultural Promises

Failure often followed faith in the malleable West. The homesteading boom in Montana typified the consequences of the overconfidence and *hubris* inherent in reclamation and dry farming. As historian of dry farming Mary Hargreaves has stated, "fluctuations in dry-land production have proved costly – both to the individuals directly concerned and to the social and political institutions with which they are related."[199] Abundant stores of energy and industrialization could work wonders in manipulating the environment, but nature has its way of responding in kind. Montana's homesteading boom busted when confronted with aridity.[200] Railroads like the Great Northern worked to promote the West and its president James J. Hill fervently believed in a garden-West. The railroads undoubtedly had power in the success and failure of towns, but they also

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[198] Donald Worster, *Dust Bowl: The Southern Plains in the 1930s* (New York: Oxford University Press, 2004), 69.
[199] Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 23, 485-536.
[200] Malone, Roeder, and Lang, *Montana: A History of Two Centuries*, 216-219.; For a popular history of this process, see: Jonathan Raban, *Bad Land: An American Romance* (New York: Pantheon Books, 1996).

bear some responsibility for the immense failures that were experienced by farmers who entered the West wanting to change its character.

The Great Northern Railway worked hard to colonize the West and by 1910, according to their General Passenger Agent, the railroad was "receiving more inquiries relative to Montana than all the other states combined."[201] At a dry land farming congress held in Billings, Montana, Hill commented, "[y]ou might put a railroad in the garden of Eden and if there was nobody there but Adam and Eve it would be a failure."[202] The reach of the railroad for future settlers of the West went well beyond the national borders of the United States.[203] They sought good agriculturalists from around the world to settle in colonies that would cooperate in procuring resources such as water and permanently reside in the West. The Great Northern Railway employed a man by the name of William Blonder in their immigration department for just such a task. His qualifications included the following, he was "a linguist, speaking six different languages, and has traveled extensively in Europe," and he was also "familiar with Government methods of handling

[201] Letter from S. J. Ellison to James J. Hill, March 30, 1910. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.; The Northern Pacific Railroad was also in the business of doing this, and by the early twentieth century this railroad was owned by Hill.; James B. Hedges, "The Colonization Work of the Northern Pacific Railroad," *The Mississippi Valley Historical Review* 13, no. 3 (1926).

[202] "Delegates Want Dry Farming to Have New Name."

[203] The Minnesota Historical Society holds the Great Northern Railway records which contain a considerable amount of correspondence regarding their immigration efforts in the following record location: 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.; There were also a number of immigration organizations that developed during this period such as the "Land and Immigration Representatives of Western Lines," "The American Immigration and Distribution League," and "National Liberal Immigration League."; In a letter to Louis W. Hill, "The American Immigration and Distribution League" asked, "Do you believe it would be better for the country and for the immigrants themselves if the tens of thousands who come to America every year could be distributed more equally throughout the various states and induced to turn into thriving cities and towns and productive farms the countless acres now undeveloped?"; Letter from Henry Green of The American Immigration and Distribution League to Louis W. Hill, February 8, 1912. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.

emigrants" and "the habits and peculiarities of the different nationalities." Blonder was also politically connected to the Superintendent of Deportation for the State of New York, and would be able to he is in a position "to get in touch with the large steamship companies."[204] The Great Northern Railway reached far and wide to get agricultural settlers on to their lands.[205]

Montana was a major draw for many emigrants.[206] The Montana homesteading boom is often described as lasting from 1900 to 1918 with the most prominent spike occurring around 1909 with the advent of dry farming, abundantly available land, and aggressive advertising by the railroads and boosters.[207] For example, a 1910 piece of domestic advertising for Montana's agricultural land "inserted by the Great Northern Railway in the leading eastern papers and principal farm magazines," stated, "[y]ou can get a 160 or 320 acre farm free in Montana – but you'll have to hurry…Montana ranks first among the states in the yield per acre of wheat, oats, rye, barley and potatoes"

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[204] Letter from W. P. Kenney to C. R. Gray, January 25, 1913. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.

[205] An example of the agricultural preferences by the railroad for immigration into Montana can be seen in a letter from C.R. Gray of the Great Northern Railway that stated "[i]nasmuch as the people from the Balkans largely follow agriculture, we conceive that they would be of the greatest possible benefit to us, because this is essentially an agricultural country."; Letter from C.R. Gray to Prof. Michael L. Pupin, January 29, 1913. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.; Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 451-452.; For a stunningly written account of an immigrant family farming in the Dakota Territory, see: O. E. Rølvaag and Lincoln Colcord, *Giants in the Earth: A Saga of the Prairie* (New York: Harper Perennial, 1999).

[206] Inquiries came in from individuals asking about the possibilities for emigrants in the state. For example, in 1913 a letter addressed to the Immigration Agent of the GNRR stated, "I have been asked for information regarding the prospects of some Irish Farmers who wish to settle in America and they are awaiting my reply as to whether they shall go to Canada or to the Western United States of America.; Letter from Rev. John Leahy to Immigration Agent G.N.R., January 15, 1913. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.; In 1904, Louis W. Hill received numbers for the national origins of the emigrants who were making their way to Montana. By far, Scandinavians were the largest group with Croatian and Slovenian, English, Finnish, German, Irish, Northern Italians, and Scotch emigrants coming in considerable numbers.; Louis W. Hill to J.G. Pyle, October 11, 1904. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.

[207] Malone, Roeder, and Lang, *Montana: A History of Two Centuries*, 178-194.; Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 133-163.

[Figure 57].[208] Furthermore, Thomas Shaw, the agricultural agent of the Great Northern and Northern Pacific railroads took on Campbell's mantel and promoted dry farming across Montana.[209] The growth can be seen in numbers provided to Louis W. Hill from his General Traffic Manager that showed that the movement of colonists to Montana had increased from 1735 in 1911 to 2533 in 1912.[210] Unsurprisingly, many of these colonists relied upon irrigation in this supposed agricultural land of Montana.[211]

The pressure of the rapid increase in immigration to Montana was not all good for the railroad. In 1917, the Great Northern Railway encountered an unexpected problem that they did not foresee in 1914 when they assessed their coal requirements. In an internal letter, Carmi A. Thompson wrote to W.P. Kenney that in 1914, "we had more coal than we wanted in Montana and did not care particularly to put in tracks any distance

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[208] Letter from S. J. Ellison to James J. Hill, March 30, 1910. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.; There was also a refrain circulating at this time that the West should absorb the unemployed and surplus population of American industrial cities. For example, a 1912 letter to Louis W. Hill described the dire conditions that had to be remedied. The letter writer was confident that "we can create a wide-spread movement of industrious men from the over-crowded cities to the uncultivated lands."; Letter from James B. Haynes to Louis W. Hill, March 8, 1912. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.

[209] Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 179-187.

[210] Letter from W.P. Kenney to Louis W. Hill, April 9, 1912. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.; The previous year (1911), the Governor of Montana, Edwin L. Norris wrote to Louis W. Hill about Hill's previous communication with Norris concerning "the heavy movement of settlers to Montana." Norris stated, "[i]t is gratifying to note that the people east of us still have an eye on Montana, and I trust that the experience of the newcomers may justify all of the good things that the Great Northern is saying of this State."; Letter from Edwin L. Norris to Louis W. Hill, March 17, 1911. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.; His qualified statement is likely drawn from the 1910 correspondence he had with Norris about the Railway's fault in misleading settlers and getting immigrants who are unable to make a living.; The rapid increase in Montana, that largely coincided with the popularity of irrigation and dry farming, can be seen in Hargreaves' analysis. See: Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 441-442, 446-449, 453-484.

[211] For example, a group of 70 colonists from Belgium migrated to Valier, Montana in 1913. The first thing that they did when they got to Valier was to sign contracts with the local irrigation company named the Valier Irrigation Project. The head of this group, Reverend Victor Day, and his colonists were very pleased with the land and their treatment and he hoped to be able to obtain more colonists for Montana in the near future.; Letter from W.P. Kenney to C.P. Gray, February 27, 1913. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.; Letter from Victor Day to the Great Northern Railway, June 22, 1913. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.

to reach mines because the coal would likely move into Great Falls and displace the coal we were already handling as there was more coal produced than a market could be found for." But with an exceptionally harsh winter and the pressures of an increasing population in Montana, Thompson was worried about a coal famine in the near future. "To my mind," he wrote, "we will need for domestic and steam consumption, every pound of coal we can get hold of…We are now very anxious to develop all the coal mines along our line in Montana."[212]

While, Hill, president of the GNRR, strictly forbade his employees, under threat of termination, from town-siting along the railroad's line, the GNRR was in the business of generating new towns and encouraged the growth of those locations in close proximity to the rail lines.[213] And, sometimes he destroyed towns by passing them by. The town of Paxton, Montana was just one of those passed over by progress. In 1911, the people of Paxton petitioned the railroad requesting an extension into their town. A shop owner, Forest R. Hopkins wrote, "[p]rospects for an abundant crop, at present, look very bright, and newcomers continue to arrive every day, and the question asked everywhere by the homesteaders, is when do the G.N.Ry. intend building the proposed Mondak Lewiston extension, and many of them filed with the expectation that same would be through before Fall of 1911, thereby being able to market their grain." Without the railroad, he

[212] Letter from Carmi A. Thompson to W.P. Kenney, May 16, 1917. 132.C.2.4.F. Great Northern Railway Company Records. Minnesota Historical Society.
[213]Letter from James Hill to E. H. Becker, June 18, 1890. James J. Hill Letterbook, 6/11/90-10/21/90, p. 13: M458 Reel 35. Minnesota Historical Society.; Malone, *James J. Hill*.; Richard White, *Railroaded: The Transcontinentals and the Making of Modern America* (New York: W. W. Norton & Company, 2011), 155-156.

noted, "it is impossible to develop the country."[214] The following year, he wrote, "[t]he people in this country are looking for the G.N.R.R. if they are sure the R.R. will be thru next year, there will be a number of thousands of acres more put in crop. As it is they are loosing faith and will not crop very heavey on acct. of the distance they have to haul their grain." Hopkins remarked on the "excellent" quality of the crops and the fact that farmers are ready to start shipping their grain.[215] As evidence of what unfolded for the town of Paxton, it no longer exists. The railroad literally made towns in the West and furthered the agricultural frontier that was built on fossil fuels and visions of malleability.[216]

Agriculture may have been the focus for the Great Northern Railway's emigration campaign, but in the midst of the Montana homesteading boom questions arose as to whether the railroad should be advertising so aggressively.[217] For example, in 1910, F. B.

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[214] Letter from Forest R. Hopkins to the President of the Great Northern Railway, May 2, 1911. 132.F.1.2.F. Great Northern Railway Company Records. Minnesota Historical Society.; The town was 30 miles south of Popular, Montana.

[215] Letter from Forest R. Hopkins to C. L. Crey, President of the Great Northern R.R., October 6, 1912. 132.F.1.2.F. Great Northern Railway Company Records. Minnesota Historical Society.

[216] For more information on railroads and settlement, see: Edward Frederic Benson, "The Problem of Land Settlement," 1922. Northern Pacific Railroad Company. PAM 2862. Montana Historical Society Research Center.; James Fredric Hamburg, *The Influence of Railroads Upon the Process and Patterns of Settlement in South Dakota* (New York: Arno Press, 1981).; Harold F. Peterson, "Some Colonization Projects of the Northern Pacific Railroad," *Minnesota History* 10, no. 2 (1929): 127-144.; Robert Edgar Riegel, *The Story of the Western Railroads, from 1852 through the Reign of the Giants* (Lincoln, NE: University of Nebraska Press, 1964), 274-288.; Richard White, *Railroaded.*; Oscar Osburn Winther, *The Transportation Frontier: Trans-Mississippi West, 1865-1890* (New York: Holt, Rinehart and Winston, 1964).; The power of the railroads to control the West in the grip of their iron rails has been criticized by many historians. For example, David Nye stated, "[t]he railroad did not open the West; it closed it to poor settlers who could not afford to pay the higher prices that property suddenly fetched along its routes. The railroad stimulated rampant land speculation and distorted normal development, driving prices up before the road was completed and, often as not, leading swiftly to depression thereafter…Worst of all from the western point of view, railroads transformed settlement from an individualistic process to a centralized corporate practice…The railroad did not bring free-market development and prosperity; it brought immediate economic disaster for some feverish land speculation, and long-term economic control for all."; Nye, *America as Second Creation*, 179.

[217] Robert William Fogel has noted that the railroads were actually not really needed to access what were in actuality viable agricultural lands. In fact, a system of canals paired with improvements and additions to existing roads would have provided access to the majority of western agricultural lands for less cost. Fogel did not address the impact of the railroads which pushed into areas that had no agricultural potential. The

Linfield of the Montana Agricultural Experiment Station in Bozeman, Montana wrote to E. C. Leedy, the Immigration Agent for the Great Northern Railway about the emigrants arriving in droves. "From information that comes to me from letters from nearly every state in the Union," Linfield explained, "there is certainly a very keen interest in Montana as an opportunity for the settler on the land." But he worried about these settlers. "It has been a question in my mind," Linfield lamented, "whether these people are not coming almost too fast." He explained his concerns:

> From my point it seems to be of paramount importance that these people succeed in their new venture in Montana, and to do so very many of them are going to need a great deal of personal help and advice. A contented and successful settler who is making his way is a most efficient advertising agency; the man who fails, gives up, and leaves; while those who fail can't leave, but have to endure hardships which will be talked about and made much of, will do more to keep settlers out and discourage the settlement of the country than many thousands of dollars will do in bringing them in. In my opinion, in this western country where peculiar farm conditions have to be met, to get people into the country is only half of the problem…To get these people steered right in the matter of methods of farming, to show them what to do to succeed, is going to be worth many times more ultimately in the success and prosperity and thorough settlement of the country than merely the getting of the people in.[218]

Linfield rightly believed that the booster campaigns that spoke of unlimited agricultural fertility and high hopes of mastering and manipulating the West would lead to disaster.

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railroads, because they were constructed and extended into regions that were not optimal agricultural land, may have done more damage to the West than a system of roads and canals that constrained and slowed western settlement.; Robert William Fogel, "Railroads as an Analogy to the Space Effort: Some Economic Aspects," Bruce Mazlish ed., *The Railroad and the Space Program: An Exploration in Historical Analogy* (Cambridge, MA: The MIT Press, 1965), 75-80.

[218] Letter from F. B. Linfield to E. C. Leedy, January 28, 1910. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.

What was needed was education and not advertising.[219] But, alas, Louis W. Hill disagreed. Writing to Governor Edwin Norris concerning the letter from Linfield, Hill stated, "I do not feel that anyone can take the responsibility of educating all the people who come to Montana to make livings for themselves. We can only handle this matter by selecting the best people we can and allowing the theory of the survival of the fittest to provide a final outcome."[220]

Unfortunately, his view dominated the West and nature did take its course. The theory that rain follows the plow, the technologies of irrigation and reclamation, and the science of dry farming, worked to encourage the belief in a malleable West. Agriculturalists found partial success by taking advantage of nature's stored capital in the soils and use of the fossil fuels. However, perpetuating visions of a plastic West impaired the ability of Americans to understand the actual climactic nature of the West.[221] Once the soils of the West were depleted, western agriculturalists were left with nothing. As a result, Montana and the rest of the West were engulfed in dust storms as the dirty thirties destroyed the lives of many and was an ecological disaster on an unprecedented scale.[222]

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[219] Linfield was not alone in his concern. Even dry farming advocates saw the need for educating farmers and a potential government role for doing so. Also, it should be noted that Linfield seemed to approve of Campbell's dry farming methods. See: Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 99, 114, 150-151, 324.

[220] Letter from Louis W. Hill to Edwin Norris, February 8, 1910. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.

[221] Libecap and Hansen, ""Rain Follows the Plow" and Dryfarming Doctrine," 113-114.

[222] For examples of literature on the Dust Bowl, see: Mathew Paul Bonnifield, *The Dust Bowl: Men, Dirt, and Depression* (Albuquerque, NM: University of New Mexico Press, 1979).; Worster, *Dust Bowl*.; William Cronon, "A Place for Stories: Nature, History, and Narrative," *The Journal of American History* 78, no. 4 (1992): 1347-1376.; Mary Murphy, *Hope in Hard Times: New Deal Photographs of Montana, 1936-1942* (Helena, MT: Montana Historical Society Press, 2003).; Richard H. Dillon, "Stephen Long's Great American Desert," *Proceedings of the American Philosophical Society* 111, no. 2 (1967): 108.; Hollon, *The Great American Desert Then and Now*, 174-177.; Hargreaves, *Dry Farming in the Northern Great Plains, 1900-1925*, 20.; Libecap and Hansen, ""Rain Follows the Plow" and Dryfarming Doctrine," 86-87.

Western settlers would seek to defy drought armored with their optimism about the changing climate until complete failure penetrated their steeled sanguinity.[223]

Conclusion

In the mind of Percival Lowell, Mars was used as an example for the future of the American West. Today, perhaps NASA should consider the American West as an example of the pitfalls of attempted mastery through techno-science. This chapter served to demonstrate the culmination of nineteenth-century America's use of geology to settle the West. From Lowell's dewatering planet to Buffalo Bill's decision to build the town of Cody on an ancient lake, the watery past of the region was incorporated into visions for the future. The rise of irrigation, reclamation, and dry farming were responses to the fact that nature was not cooperating in civilizing the West. Rain was not following the plow, no matter how deep the furrow cut. Nevertheless, confronted with the unceasing aridity of the West, Americans continued to respond with optimism about its malleability.

One of the most powerful forces in reshaping the West was the imagination. At the turn of the century, the desert-West had faded out of memory through the use of science and technology. These forces remade the West physically and in the imagination. For example, by 1905, a reporter could comment that he vaguely remembered the effect of learning about the Great American Desert as a schoolboy. While he was taught that it was a very real geographical feature of the West, he soon learned that it was an "outgrowth of ignorance," and "is a thing of the past." Furthermore, according to the

[223] Kutzleb, "Rain Follows the Plow: The History of an Idea," 383, 391.; Allen, "The Garden-Desert Continuum," 214-217.

reporter, "[i]t never had a real existence except in the imaginations of superficial explorers and ignorant geographers." In reality, he concluded, "[t]he Great American Desert is really an important part of the granary of the world."[224]

The basis for this dramatic shift in the imagination of Americans was found in the earth. Geological history continued to provide an example for a possible future and an explanation for the agricultural potential of western soils. Coal had granted American's an unbounded faith in the power of science and technology in controlling nature. The railroads continued to link into the popular arid lands agricultural science of the day and helped to spread this knowledge and settlers throughout the West.

In the late nineteenth and early twentieth centuries, Americans could no longer wait for nature to take its course and change the West's climate. Americans realized that the only way to do so was by force. This chapter serves as a culmination of the philosophies discussed in this dissertation. Coal had convinced many of humanity's privileged position as masters of the Earth. For decades, Americans has also conceived of the West as a plastic place. While its natural plasticity was up for debate at the close of the nineteenth century, there was little doubt what humans could do with fossil fuels like coal. Malleability paired powerfully with mastery at the turn of the century and yielded massive irrigation works and last ditch efforts to scientifically sort out farming in arid regions.

[224] "The Great American Desert." *The Washington Times*, April 2, 1905.

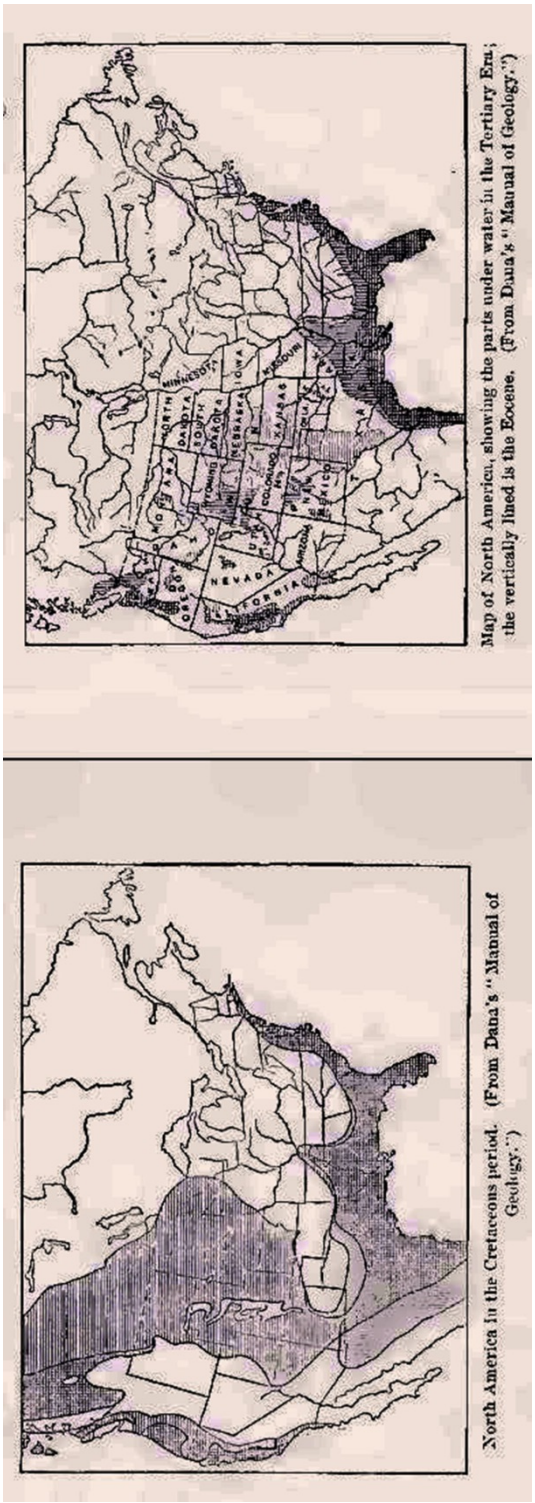


Figure 53. Lowell's use of Dana. Source: Percival Lowell, *Mars and Its Canals* (New York: The Macmillan Company, 1911), 136-137.

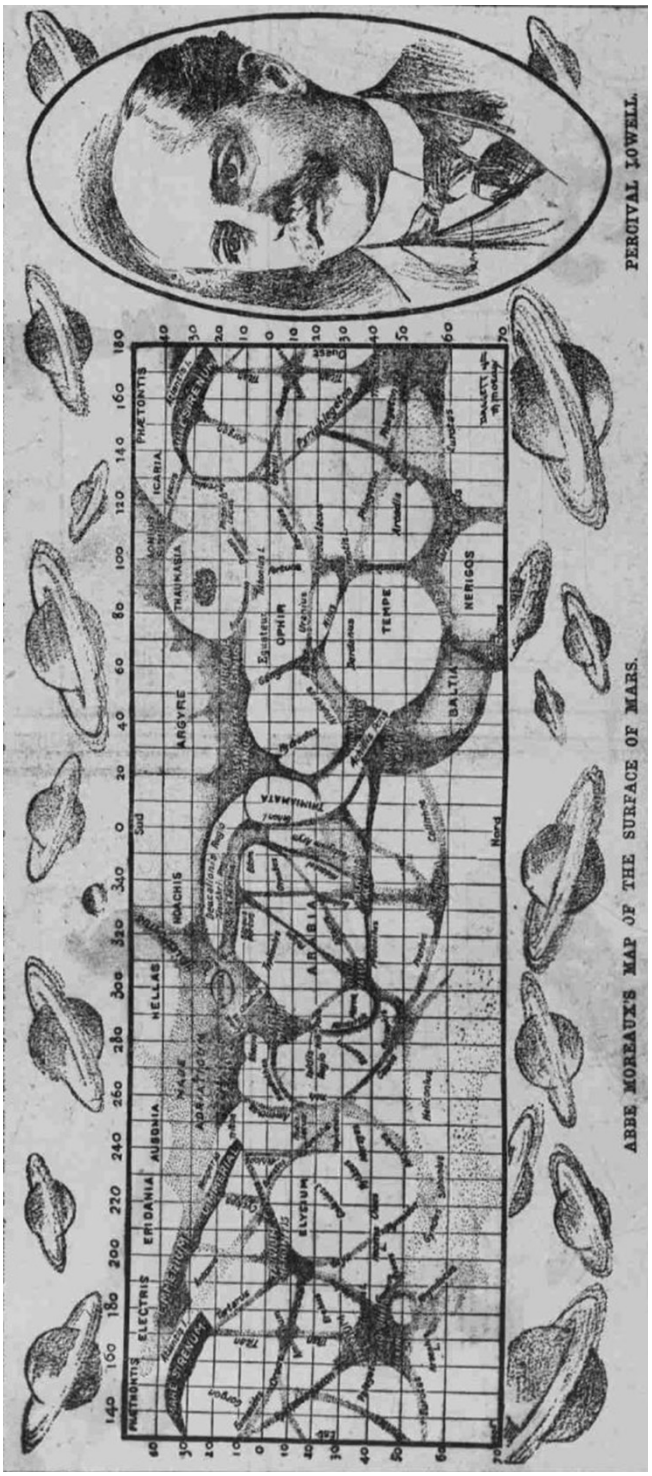


Figure 54. Lowell in the news. Source: “Still Searching for the Inhabitants of Mars,” *The Topeka State Journal*, August 03, 1907.

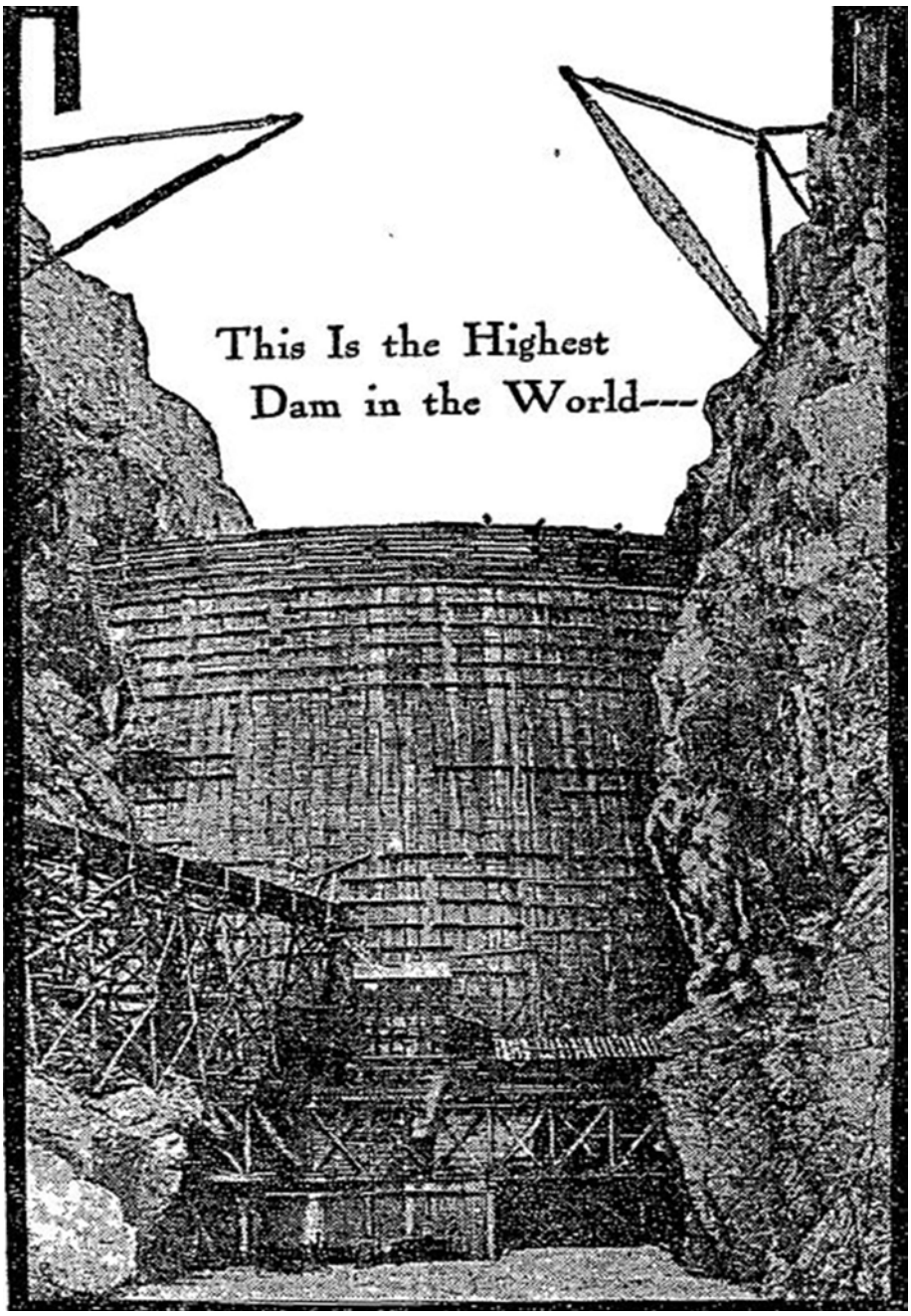


Figure 55. Shoshone Dam. Source: “A New Wonder of Irrigation in the West.” *New York Times*, February 6, 1910.



Figure 56. “The Camel for the Sahara Desert; The Campbell Method for the American Desert.” Source: Hardy Webster Campbell, *Campbell's 1907 Soil Culture Manual: A Complete Guide to Scientific Agriculture as Adapted to the Semi-Arid Regions* (Lincoln, NE: The Campbell Soil Culture Co. (Inc.), 1907).



Figure 57. "Your Chance is West," (1910). Source: Letter from S. J. Ellison to James J. Hill, March 30, 1910. 132.E.14.1.B. Great Northern Railway Company Records. Minnesota Historical Society.

CONCLUSION – THE RETURN OF CLIMATES PAST: CLIMATE CHANGE AND THE WILDING OF COAL

Photos of the Earth from space as captured by the ATS-3 weather satellite in 1967, and the Apollo 17 mission five years later, gave Americans an iconic image often called the "Blue Marble." These images had a significant cultural impact as the modern environmental movement was getting off of the ground.[1] For example, these "Blue Marble" images graced many of the early covers of the *Whole Earth Catalog*, a magazine that was a mainstay and powerful force in the modern environmental movement, particularly for those interested in appropriate alternative technologies and ecological design [Figure 58]. [2] Set against the deep black of space, the image emphasized to many Americans the fragile nature of the Earth. Dominated by the color blue, the image clearly showed that the Earth was predominantly covered by water. More recently, though, the image that has replaced the "Blue Marble" is what we might call the "Black Marble." NASA's images of the earth at night show how much black fossil energy Americans use to fight the darkness [Figure 59]. In fact, one of the image files for this set of NASA photographs is appropriately labeled "black_marble."[3] Indeed, this may be a more

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[1] For more information on the modern environmental movement, see: Robert Gottlieb, *Forcing the Spring: The Transformation of the American Environmental Movement* (Washington, DC: Island Press, 1993).; Samuel P. Hays and Barbara D. Hays, *Beauty, Health, and Permanence: Environmental Politics in the United States, 1955-1985* (New York: Cambridge University Press, 1987).; Adam Rome, *The Genius of Earth Day: How a 1970 Teach-in Unexpectedly Made the First Green Generation* (New York: Hill and Wang, 2013).; Hal Rothman, Gerald D. Nash, and Richard W. Etulain, *The Greening of a Nation?: Environmentalism in the United States since 1945* (Fort Worth, TX: Harcourt Brace College Publishers, 1998).; Kirkpatrick Sale and Eric Foner, *The Green Revolution: The American Environmental Movement, 1962-1992* (New York: Hill and Wang, 1993).

[2] Andrew G. Kirk, *Counterculture Green: The Whole Earth Catalog and American Environmentalism* (Lawrence, KS: University Press of Kansas, 2007).

[3] "City Lights of the Americas," NASA Visible Earth: A catalog of NASA images and animations of our home planet, accessed March 15, 2015, http://visibleearth.nasa.gov/view.php?id=79787.

appropriate label than NASA realizes given that black fossil fuels energize our lives and have such an impact that we can see them from space.

Westerners were once water people; that was their primary environmental concern. In his *The American West as Living Space*, Wallace Stegner asserted that "[t]he West is defined…by inadequate rainfall, which means a general deficiency of water."[4] Also, water was such a vital resource in the West that, according to Donald Worster, it became a "tool of empire."[5] However, the reality is that energy is a far more powerful tool in shaping the West than is water alone. As soon as Americans began to tap into the subterranean frontier and draw out its fossils and fossil fuels, water was less of a concern. Worster's "hydraulic society" relied more on energy than water in concentrating social power.[6] There could be no massive dams without a technocratic society built on energy abundance and the belief that humanity was a righteous geological agent. Taking energy as a background resource or as a given in industrial society naturalizes its use. Yet in this dissertation, I have tried to denaturalize this high-energy American society that has performed the litany of wrongs which Worster details in his histories.

Making energy the center also allows us to broaden our scope of analysis. By using the remnants of paleo-environments, we have become energy people – connected not just to local waterways, but to much wider earth systems. Water ties us to the present, yet energy drives our future environmental decisions and connects us to the deep past.

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[4] Wallace Stegner, *The American West as Living Space* (Ann Arbor, MI: University of Michigan Press, 1987), 6.
[5] Donald Worster, *An Unsettled Country: Changing Landscapes of the American West* (Albuquerque, NM: University of New Mexico Press, 1994), 31.
[6] For more information concerning Worster's "hydraulic society," see: Worster, *An Unsettled Country,* 43.; Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West* (New York: Pantheon Books, 1987).

Water remains central to environmental politics in the West, but energy masks many environmental resource issues. Properly applied, energy has the potential to reduce an array of natural resource issues to a single factor – how much energy we have to put to use in our technologies. Fossil energy released humans from natural checks on settlement size and recast other resource concerns as primarily being problems of energy. The West has a lot of energy, but it is the product of geological processes that take longer than most people can fathom. This is part of the problem. How we imagine our environment and natural resources plays a very large role in how we use them. Paleo-environments and their remnant fossils and fossil fuels that now lie under the West, have played and continue to play a central role in how this imaginative process unfolds. We cannot appreciate the fullness of America's history without addressing the deep history of the American West.

In the context of a high-energy society, the root causes of global climate change and the possibilities of geoengineering solutions lie in humanity's willingness to selectively accept certain elements of science, while rejecting others. How these decisions were made in the past, and will be made in the future, is wholly a cultural process. As this dissertation has made clear, the geologic history of the earth can be used to support a wide variety of agendas, such as the rapid settlement and reengineering of the American West. In large part what enabled this selective understanding was the surge in American industrialization through the use of fossil fuels after the Civil War.

Industrialization unwilded geological history in its attempt to tame and master nature to suit human desires. Yet instead of environmental mastery, this path entered

humans into an envirotechnical relationship with the natural world that embedded us so deeply that "normal accidents" were simply part of the system, occurring on an ever-grander scale in tune with our ever-grander ambitions.[7] Perhaps most extraordinarily, coal not only had the ability to physically energize concrete processes and machinery, but to also energize the American imagination in unprecedented ways. Fossils illustrated that the natural world was plastic on a vast geohistorical scale. Through their intimate use and partnership with these energetic material remains of geologic time, western Americans came to see their role as superseding geological processes, in order to shape the world to suit human needs and desires. America is a nation built on its geology. Geoengineering is America's birthright.

Deep time and the geologic history of Earth are near impossible for most of us to fathom. Geologists have long worked with metaphors to assist lay people in conceptualizing the vast expanses of time required for geological processes. The most common method is the use of a timeline that represents our (humanity's) insignificant place in the planet's lifecycle. This depiction can say a great deal about humanity's relationship to the natural world. As an animal among many in a long chain of being, a degree of humility is derived from considering geologic history. Deep time would seem to favor the view that humans have no choice but to reconcile their ambitions with nature and adapt to the will of geologic forces.

The history of geologic history and deep time in the American West, however, is a different tale. Just as geologic history was entering into the public consciousness

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[7] Charles Perrow, *Normal Accidents: Living with High-Risk Technologies* (Princeton, NJ: Princeton University Press, 1999).

through the ancient material remains found in the subterranean frontier, equally ancient fossil fuels were helping to ease any sense of inadequacy that Americans might have felt in confronting deep time. Fossil fuels that energized American industrialization illustrated to most Americans that humanity was not insignificant after all. Rather, humans could be a force of nature that would seduce or dominate non-human nature according to humanity's hopes and desires. But what would the world of humanity's choosing look like? The Bible presented an attractive option in the Garden of Eden. Science also provided the possible means of returning to the earlier and greener environments that once visited the West, a path to a Second Eden. Both sources saw the world as malleable, and fossil fuels granted proof of humanity's dominance and power to change the world on a massive scale. Deep time did not necessarily matter. Humans would not be relegated to a trivial spot on the cosmic timeline.

The following sections will bring the narrative offered in this dissertation to the present day. Through the coal stripping operations in-and-around Colstrip, Montana, to the flaring oil fields of the Bakken Formation in North Dakota, it is evident that the historical threads and ideologies of the late nineteenth and early twentieth century remain today as Americans continue to take advantage of energy abundance. The result, it would seem, has been a series of environmental and social consequences. I conclude by briefly considering how the history of the American West might inform the ways we think about the Anthropocene and contemporary climate change.

Colstrip, Montana: Stripping Coal for Cleaner Air

The town of Colstrip is no longer the verdant tropical paradise to which it owes its existence. In the days before industrial coal extraction, the Crow knew this area as "Where the Enemy Camps" and "Where the Colts Died."[8] It is now an arid landscape in eastern Montana, where coal from the K/T boundary (primarily the Tertiary of the Fort Union Formation) powers industrial machinery and the local economy. Colstrip had humble beginnings as a coal extraction waypoint to fuel the transcontinental locomotives of the Northern Pacific Railroad (NPRR) in 1924 [Figure 60]. Mines in Red Lodge, Montana, had met the demands of the NPRR up until just after World War I when labor troubles and high transportation costs forced the railroad to seek additional coal sources.[9] By the 1920s, coal use in the United States and Montana began a slow and steady decline in relative energy market share in the face of rising petroleum production.[10] Nevertheless, with only one significant drop in production during the Great Depression, coal continued to play a prominent role in the industrial economy and coal production endured in

[8] David T. Hanson and Rick Bass, *Colstrip, Montana*, (Fairfield, Iowa: Taverner Press, 2010), ii.
[9] Bonnie Christensen, "'Nothing up Here but Foreigners and Coal Slack': World War I and the Transformation of Red Lodge," *Montana: The Magazine of Western History* 52, no. 3 (2002/10/01/ 2002): 16-29.; Bonnie Christensen, *Red Lodge and the Mythic West: Coal Miners to Cowboys* (Lawrence, KS: University Press of Kansas, 2002).; William B. Evans and Robert L. Peterson, "Decision at Colstrip: The Northern Pacific Railway's Open-Pit Mining Operation," *The Pacific Northwest Quarterly* 61, no. 3 (1970): 130.; Shirley Zupan, Harry J. Owens, and Carbon County Historical Society (MT), *Red Lodge: Saga of a Western Area* (Red Lodge, MT: Carbon County Historical Society, 1979).; For information on the locomotive technology used following the creation of the town of Colstrip, see: R.L. Frey and L.P. Schrenk, *Northern Pacific Railway: Supersteam Era, 1925-1945* (San Marino, CA: Golden West Books, 1985).
[10] Martin V. Melosi, *Coping with Abundance: Energy and Environment in Industrial America* (Philadelphia, PA: Temple University Press, 1985), 24-29, 139-145.; David E. Nye, *Consuming Power: A Social History of American Energies* (Cambridge MA: The MIT Press, 1998), 196-199, 225, 232.

Montana.[11] In 1958, however, the NPRR could no longer resist the momentum of dieselization and sought to sell the Colstrip mines.[12]

Following a dip in coal production in the late 1950s, Montana Power Company bought the mines in 1959 and revived strip-mining shortly before the 1970s energy crises.[13] Stronger air pollution regulations sparked new interest in western coal reserves during the energy crises, as energy companies were forced to search out the lower-sulfur coal sources of the West located around the K/T boundary. Even before the energy crises began, strip mining for coal was becoming a viable option for many enterprising energy companies. For example, a 1971, *New York Times* article titled "Coal Rush Is On as Strip Mining Spreads Into West," covered the reasons for the rush to lease coal in the West, strip mining environmental impacts, and the locations of the largest coal deposits in the region. The article explained that the chief reserves were in Montana, Wyoming, and New Mexico, and were largely on either Native American reservations, railroad grants, or public lands.[14] The following year, the *New York Times* reported on an ecological study

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[11] Richard Bonskowski, William D. Watson, and Fred Freme, "Coal Production in the United States-An Historical Overview," Energy Information Administration, October 2006; http://www.eia.gov/cneaf/coal/page/coal_production_review.pdf.; Evans and Peterson, "Decision at Colstrip."

[12] Evans and Peterson, "Decision at Colstrip," 136.; "NP to Close Down Colstrip Operation; Company Town Left With Bleak Future," *Great Falls Tribune*, January 25, 1958.; Robert A. Chadwick, "Coal: Montana's Prosaic Treasure," *Montana: The Magazine of Western History* 23, no. 4 (1973): 31.; A former brakeman for the Northern Pacific railroad did not understand why they made this transition to diesel with the abundant coal resources that were present throughout the West. He stated, "[y]ou know, the Northern Pacific owned that mine down there, and that land, I don't know why they went to diesel engines when they owned that coal...I don't know why, kinda funny, they had good engines, too. Gee, they had good engines. Some of them were brand new. Funny thing, they always say it's progress, but sometimes we can't see where the progress comes in."; "Al Olson interview, 1981 Sept. 21," Montana Historical Society Research Center, OH 194.: For discussions of "technological determinism" and "technological momentum," see: Merrit Roe Smith and Leo Marx eds., *Does Technology Drive History?: The Dilemma of Technological Determinism* (Cambridge, MA: MIT Press, 1994).

[13] Chadwick, "Coal: Montana's Prosaic Treasure," 31.

[14] Ben. A. Franklin, "Coal Rush Is On as Strip Mining Spreads Into West," *The New York Times*, August 22, 1971.

of strip mining practices done by an organization called Friends of the Earth that detailed the acreage of disturbed land and environmental impacts of proposed strip mines.[15]

For Westerners, strip mining brought hard decisions and disputes to their communities.[16] For some struggling ranchers, selling parcels of their land to the energy companies was a viable option to secure their future. However, environmentally conscious residents were wary and unconvinced of the energy-company promises to reclaim their land. [17] This unease arose from the nature and hard realities of mining diffuse coal resources and processing them for energy transmission. Not only is coal extraction by strip-mining a form of fossil-fuel-powered "mass destruction," it is environmentally costly due to the emission of large amounts of greenhouse gasses resulting from burning it as an energy source.[18] Coal strip-mines in the industrial West, as author John McPhee described, are "no less than an erupting volcano…a point in the

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[15] Ben A. Franklin, "Ecologists Make Strip-Mine Study," *The New York Times*, January 30, 1972.
[16] Franklin, "Coal Rush Is On as Strip Mining Spreads Into West."; Calvin Kentfield, "New Showdown in the West: 'We want that coal under your soil!' 'We want to keep the Big Horn, Recluse, Acme and Rosebud as they are!'" *The New York Times*, January, 28, 1973.; Douglass E. Kneeland, "To Ranch in West: Or Strip for Coal: A Difficult Choice," *The New York Times*, February 18, 1974.; Northern Plains Resource Council, *The Great Debate: Colstrip Units 3 & 4* (Billings, MT: Northern Plains Resource Council, 1974).; Robert A. Wright, "Revival of Coal Mining in Energy Crisis Divides West," *The New York Times,* April 2, 1973.
[17] Historical treatment of this concern in the West has often been analyzed through the "Plundered Province Thesis" established by Bernard DeVoto, which sees the West as an exploited colony of the East.; Douglas Brinkley and Patricia Nelson Limerick eds., *The Western Paradox: A Conservation Reader: Bernard DeVoto* (New Haven, CT: Yale University Press, 2001).; Jeff Goodell, *Big Coal: The Dirty Secret Behind America's Energy Future* (New York: Houghton Mifflin Company, 2006).; William G. Robbins, "The 'Plundered Province' Thesis and the Recent Historiography of the American West," *Pacific Historical Review* 55, no. 4 (Nov., 1986): 577-597.; Claire Strom, *Profiting from the Plains: The Great Northern Railway and Corporate Development of the American West* (Seattle, WA: University of Washington Press, 2003).; K. Ross Toole, *The Rape of the Great Plains: Northwest America, Cattle and Coal* (Boston, MA: Little, Brown and Company, 1976).
[18] Timothy J. LeCain, *Mass Destruction: The Men and Giant Mines that Wired America and Scarred the Planet* (New Jersey: Rutgers University Press, 2009), 210-211.; On carbon emissions see also: B. D. Hong, and E. R. Slatick, "Carbon Dioxide Emission Factors for Coal," U.S. Energy Information Administration: Independent Statistics and Analysis, accessed March 28, 2013, http://www.eia.doe.gov/cneaf/coal/quarterly/co2_article/co2.html.

world where geologic time and human time overtly commingled."[19] This was confidently expressed in a 1935 pamphlet from the NPRR which stated that seen from the sky, a "photograph of the field gives the appearance of a chain of mountains which has been made by first moving the earth to expose the coal" [Figure 61].[20] However, even in the face of this destruction, the ancient landscapes held their sway on the imagination. In the midst of the first energy crisis of the 1970s, a *New York Times* reporter described a proposed western strip-mining site as "a vast ancient sea floor blanketed with dry, golden grass, sagebrush, greasewood and tumbleweed, eroded by wind, broken by dark ridges of cedar and Ponderosa pine; a country that heaves and rises in great broad swells."[21] The West is a land of contradictions, and it is the meaning that is drawn from these dueling visions that influence human-environment relations.

A different type of reclamation that is specific to mines is occurring today on the lands disturbed by extracting coal. This different form of reclamation does not aim to water arid lands, but to repair ecologically damaged mining landscapes to a scientifically and aesthetically determined pre-disturbance state. Yet, common ground exists between reclaiming water and reclaiming a lost past. Both reflect a superficial concern about natural limits and an incredible faith in science and technology to remedy the negative effects of a world of limits. For example, a 1967 report from the Department of the Interior made plain the concerns and objectives that made mine reclamation a necessity. "From this rich storehouse of soil, waters, plants and mineral deposits," the Secretary of

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[19] John McPhee, *Annals of the Former World* (New York: Farrar, Straus and Giroux, 1998), 407.
[20] "The World's Largest Open Pit Coal Field: An Engineering Marvel along the Route of the Northern Pacific RY. U.S.A." 134.H. 10.6 F, Northern Pacific Railroad Records. Minnesota Historical Society.
[21] Kentfield, "New Showdown in the West."

the Interior Stewart Udall confidently stated in 1967, "we have made prodigious withdrawals; first to satisfy the relatively simple needs of the pioneer and, secondly, to fulfill the requirements of the world's most advanced industrial economy." But not all was well in how we extracted this abundance. "In the process of those withdrawals," Udall worried, "we have looted and ravished the land; we now find that our storehouse is not exhaustible."

However Udall thought that we should not blame ourselves for the ignorance that caused this destruction: given "the desperate need of a lusty young country to feed and develop itself and the earlier limitations of knowledge and technology – some tolerance may be justified. Indeed, it might even be said truly that without such an approach the United States probably would not have reached its present economic levels." Also, President Lyndon B. Johnson did not fear the consequences of ravishing the land. While he believed in conservation, he confidently proclaimed, "*[t]he science that has increased our abundance can find ways to restore and renew an environment equal to our needs.*"[22] There was even a side-benefit of mine reclamation that directly related to early forms of western water reclamation. In a section titled "Beneficial Effects of Surface Mining," the author noted that "[i]n the Western United States, some surface mines have exposed ground water sources and made water available where none existed before."[23] The message that the document seemed to be sending was that, with the proper application of science and technology, natural limits and the destruction of the environment could be

[22] Italics added by author Stewart Udall.; "Surface Mining and Our Environment: A Special Report to the Nation." United States Department of the Interior, (Washington: United States Government Printing Office, 1967), 3-4.
[23] "Surface Mining and Our Environment," 64.

managed. For decades, scientists have attempted to perform this miracle on the stripped areas of Colstrip and its surrounding coal mines.

Strip-mining continues into the present and reclamation scientists in Colstrip, since the 1970s, persevere in their goal to heal an ancient seascape destroyed for its harvests [Figure 62]. [24] Today, Colstrip is a massive "mine-mouth" operation where coal is stripped from the Rosebud Mine's twenty-four-foot-thick seam and travels along conveyor belts to Colstrip's four coal-fired power generating units that, combined, produce 2,094 megawatts of electricity.[25] Before accessing the seam, one hundred feet of overburden must be removed by three Marion 8050 draglines that each weigh six-and-a-half million pounds with sixty cubic yard buckets, and one Marion 8200 dragline weighing eight-and-a-half million pounds with an eighty cubic yard bucket.[26] Then

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[24] Hanson and Bass, *Colstrip, Montana*.; For examples of 1970s reclamation reports see: Geological Survey (U.S.), *Proposed Plan of Mining and Reclamation, Big Sky Mine, Peabody Coal Company, Coal Lease M-15965, Colstrip, Montana: Final Environmental Statement*, 2 vols. (Reston, VA: The Survey, 1974).; Geological Survey (U.S.), Montana. Department of State Lands, and Peabody Coal Company (Saint Louis, MO: Rocky Mountain Division., *Final Environmental Statement: Proposed Plan of Mining and Reclamation Big Sky Mine, Peabody Coal Company, Coal Lease M-15965 Colstrip, Montana*, 2 vols. (Billings, MT: Montana Land Office, 1971).; Richard L. Hodder, Western Energy Company, and Montana Agricultural Experiment Station., *Coal Mine Land Reclamation Research, Located at Western Energy Company, Colstrip, Montana : Progress Report, 1971*, Research Report / Montana Agricultural Experiment Station, Montana State University, Bozeman (Bozeman, MT: The Station, 1972).; Richard L. Meyn et al., *Research on Reclamation of Surface Mined Lands at Colstrip, Montana: Progress Report, 1975*, Research Report - Montana Agricultural Experiment Station 101 (Bozeman, MT: Montana Agricultural Experiment Station, Montana State University, 1976).; Brian W. Sindelar, Richard Atkinson, Mark Majerus, Ken Proctor, *Surface Mined Land Reclamation Research at Colstrip, Montana: Progress Report, 1973-74: Research Report* 69 (Montana State University, Bozeman, MT: Montana Agricultural Experiment Station, 1975).; Brian W. Sindelar and Westinghouse Electric Corporation. Environmental Systems Department, *A Report of Natural Revegetation on Abandoned Coal Spoils in the Colstrip, Montana Vicinity* (Bozeman, MT: Animal & Range Dept., Montana State University, 1973).; For a summary of recent reclamation efforts, see: Energy and Telecommunications Interim Committee, "Rosebud Mine, Western Energy Company, a Westmoreland Mining LLC Company: Tour Fact Sheet - 2007," Exhibit 2 (2007).

[25] Puget Sound Energy, "Colstrip Generating Station: A reliable, low-cost power source," accessed March 28, 2013, http://pse.com/aboutpse/PseNewsroom/MediaKit/064_Colstrip.pdf.; Energy and Telecommunications Interim Committee, "Rosebud Mine," 1.

[26] Energy and Telecommunications Interim Committee, "Rosebud Mine," 2, 4.

twelve haul trucks, three end loaders, and one excavator remove coal from the seam.[27] After the coal makes its way along a system of conveyor belts, coal-fired generating units one and two consume "2.8 million tons, or the equivalent of 255 trains a year," and units three and four consume "6.4 million tons, or the equivalent of 75 trains per month or 2 ½ trains per day."[28] The electricity is then sent though transmission lines to Townsend, Montana, and conducted through the Bonneville Power Administration's transmission system to other independent utility grids where the energy to "supply about 1.75 million typical homes" is disbursed to western communities.[29]

What sites like Colstrip will mean for the future is uncertain. Yet it has become fairly clear that towns built on the visions and resources of geologic time are often unsustainable. It is also evident that coal is a natural resource that continues to fuel American society. But it does not just provide material power. Coal provides social power and sustains America's faith in defying natural limits through science and technology. Today, oil and gas compliment coal, and so, to these resources we shall turn next.

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[27] Westmoreland Coal Company, "Western Energy Company – Rosebud Mine," accessed March 28, 2013. http://www.westmoreland.com/rosebud.

[28] PPL Montana, "Economic Benefits of the Colstrip Steam Electric Station," accessed March 28, 2013, http://www.pplmontana.com/NR/rdonlyres/427541B2-7CAF-449A-85F9-D2CB68C258BE/0/Handout_ColstripPublicMeeting_Nov2011.pdf.

[29] PPL Montana, "Economic Benefits of the Colstrip Steam Electric Station."; Puget Sound Energy, "Colstrip Generating Station: A reliable, low-cost power source," accessed March 28, 2013, http://pse.com/aboutpse/PseNewsroom/MediaKit/064_Colstrip.pdf.; For historical treatments of energy transmission see: Thomas P. Hughes, *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore, MD: The Johns Hopkins University Press, 1983).; David E. Nye, *Electrifying America: Social Meanings of a New Technology, 1880-1940*, (Cambridge, MA: The MIT Press, 1991).

The Bakken's Boom:
Drilling, North Dakota from Space, Dams, and Dispossession

Successful commercial drilling for oil in the North Dakota's Williston Basin began with the Clarence Iverson #1 well that went into production in 1951. Just a few years later and miles away, the first productive wells in the Bakken Formation were drilled.[30] The formation was named after Henry Bakken, the landowner where it all started. It was very soon recognized by oil and gas professionals that there was something special happening in the Williston Basin. For example, a 1954 report put out concerning oil and gas in Montana noted that since 1951, news of oil in the region made it so that "the man in the street is quite conscious of unprecedented activity."[31]

Production really began in 1953 and grew in accordance with technological changes and markets.[32] In 2005, advances in horizontal well technology paired with hydraulic fracture stimulation to create large yields and more opportunities.[33] By December 2013, drilling in the Bakken surpassed 1 million barrels produced per day.[34] Another measure of the scale can be seen in the fact that between 2008 and 2013, 4,000 wells were drilled in the Bakken Formation.[35] Furthermore, the oil extraction process also yields natural gas. However, due to the general lack of infrastructure to take advantage of

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[30] "First North Dakota Oil Well," American Oil & Gas Historical Society, accessed September 12, 2014, http://aoghs.org/states/north-dakota-williston-basin/.
[31] "A Report on Oil and Gas in Montana," January, 1954. S 622.338 Oi5r. Montana Historical Society Research Center.
[32] J. R. Hamke, L. C. Marchant, and C. Q. Cupps, "Oilfields in the Williston Basin in Montana, North Dakota, and South Dakota," United States Department of the Interior, Bureau of Mines, Bulletin 629, 1966.
[33] Stephan Nordeng, "A Brief History of Oil Production from the Bakken Formation in the Williston Basin," *Geo News* (January, 2010): 5-9.
[34] Dan Sharp, "Shale year-in-review," *Bismarck Tribune*, December 10, 2014.
[35] "Assessment of Undiscovered Oil Resources in the Bakken and Three Forks Formations, Williston Basin Province, Montana, North Dakota, and South Dakota, 2013," National Assessment of Oil and Gas Fact Sheet, United States Geological Survey (April, 2013).

this valuable resource, in years like 2011, one-third of the natural gas was flared.[36] The extractive work being done in the Bakken is contributing to CO_2 in the atmosphere as it is powering our industrial society and enabling the continued reclamation of the West. NASA's nighttime photography of Earth that I have termed the "Black Marble," clearly shows the impact of flaring great quantities of natural gas in North Dakota. The Bakken looks like an illuminated city around the size of Chicago [Figure 63].

A particularly comical element of the practice of hydraulic fracturing, or "fracking," that has helped create this situation are attempts that have been made to clean up its public image. An example that pertains directly to this dissertation is the use of dinosaurs as marketing icons for petroleum companies. Talisman Terry "your friendly Fracosaurus" came into being in 2010 from Talisman Energy, an oil and gas company working on the Pennsylvania-New York border. Talisman created Terry to teach kids about hydraulic fracturing, the uses of natural gas, and the reclamation of well-pads. Interestingly, using a bucolic drawing of happy dinosaurs enjoying themselves along a richly-wooded river, Terry explained that fossil fuels come from "organic material" [Figure 64].[37] This is more than a little perverse, not to mention scientifically misleading. Talisman Energy, however, is not the only energy company to use a dinosaur as a mascot. Sinclair Oil had "Dino" the brontosaurus who has been featured in at least two World's

[36] "Over one-third of natural gas produced in North Dakota is flared or otherwise not marketed," November 23, 2011, Today in Energy, U. S. Energy Information Administration, accessed March 17, 2015, http://www.eia.gov/todayinenergy/detail.cfm?id=4030.; "North Dakota aims to reduce natural gas flaring," October 10, 2014, Today in Energy, U. S. Energy Information Administration, accessed March 17, 2015, http://www.eia.gov/todayinenergy/detail.cfm?id=18451.
[37] Talisman Energy USA, Inc., "Talisman Terry's Energy Adventure," 2010.

Fairs [Figure 65].[38] The public interest in and domestication of dinosaurs for energy boosting purposes has not become extinct.

The social consequences that have been associated with settlement, water, and natural resource extraction in this region, however, are not humorous. While the oil and gas boom was getting off of the ground, a large irrigation project was also beginning. It aimed at controlling the powers of nature and irrigating the Eden of North Dakota. The Garrison Dam was implemented by the United States Bureau of Reclamation's institutional rival, the Army Corps of Engineers. They were headed by Colonel Pick who seemed simply to be mad at the Missouri River for flooding and being generally unruly. He was not the only one angry at the Missouri's defiance. A 1953 *New York Times* article stated that the Missouri River's "history is one of violence and destruction," and that it would now be faced with opposition by engineers and construction crews.[39] Now, the connection between oil and water may be unclear, but one must recognize the technologies required to build this project and the eventual impact of oil development in the region.

An aspect of this story that should not be forgotten is its connection to Native American dispossession. Once again, remember that social power is often derived from physical power. The technocratic vision that created the Garrison Dam had the power of the U. S. Government and vast stores of fossil energy behind it. Furthermore, this was during the era of termination where Congress advanced another attempt at forced

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[38] "Evolution of the Company Symbol," Sinclair History, accessed June 10, 2013, www.sinclairoil.com/history/symbol_01.html.; "Driving to Chicago for World's Fair," *New York Times*, July 16, 1933.; Advertisement, "Sinclair H-C Gasoline Advertisement," *The New York Times*, September 28, 1933; Philip H. Dougherty, "For Kiddies: Rides and Ducks and…" *New York Times*, April 21, 1965.
[39] Seth S. King, "Huge Dam Rising to Foil Missouri," *New York Times*, April 14, 1953.

assimilation on Native American tribes.[40] The town of Williston had already been granted a reclamation project that irrigated lands ceded by local tribes around Fort Buford.[41] In the eyes of the Reclamation Service historian, George Wharton James, this region would also be of use due to its lushly forested and watery geologic past and the resulting "beds of lignite coal, which exist in the vicinity of the Williston Project." This region of North Dakota was once dotted with "the popular, and the sequoia, or redwood, related to the giant trees of the Pacific Coast." [42] James was not aware of the vast stores of oil that were also a product of this past. Thus, the area had already been subject to dispossession for the purpose of reclamation.

In the middle of the twentieth century, the Garrison Dam project was implemented by the Army Corps of Engineers. Under the Bureau of Reclamation, these lands were understood to be fertile and well-suited for wintering cattle. The Corps had other ideas and intended to tame the Missouri for power generation and flood control. These two agencies advanced competing plans to tame and utilize the wild nature of the Missouri. With strong pressure from Franklin Delano Roosevelt and Congress, the two plans were in effect melded together under the Pick-Sloan Compromise.[43] The Corps plan contained the gigantic Garrison Dam. It was reported that it was to be 20 stories high and "contain 70,000,000 cubic yards of earth and stone, enough to swallow up nearly

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[40] For histories of the termination policy, see: Kenneth R. Philip, *Termination Revisited: American Indians on the Trail to Self-Determination, 1933-1953* (Lincoln, NE: University of Nebraska Press, 2002).; Roberta Ulrich, *American Indian Nations from Termination to Restoration, 1953-2006* (Lincoln, NE: University of Nebraska Press, 2010).
[41] George Wharton James, *Reclaiming the Arid West: The Story of the United States Reclamation Service* (New York: Dodd, Mead, and Company, 1917), 263.
[42] James, *Reclaiming the Arid West*, 265.
[43] Toni Rae Linenberger, "Overview: Pick-Sloan Missouri Basin Program," Bureau of Reclamation (1998).

twenty times the bulk of the Great Pyramid in Egypt."[44] This was truly to be a masterpiece of American engineering to rival the great civilizations of old. It is now the 3rd largest reservoir in the U. S. spanning over 11,300 feet and containing 1,500,000 cubic yards of concrete.[45] Technofaith and the unwavering belief that the West was or would be dominated and remade into what Americans thought it should be are plainly evident in this story.[46]

Modifications were made to the project in order to protect white communities such as Williston, but the same cannot be said for the Native American communities that would be inundated. A large portion of the Fort Berthold Reservation that contained members of the Mandan, Hidatsa, and Arikara tribes would be flooded as a result of the dam. The residents of Fort Berthold realized that the effect would be disastrous for the tribe.[47] They implored the government to stop their plans. But once the Department of the Interior, the parent of the Bureau of Indian Affairs, got behind the project, the Native Americans had little recourse but to ask for moderate compensation: more land to replace that which would be inundated, some free electricity from the dam, the ability to continue to allow their cattle to graze around the reservoir, and first dibs on the wood from the

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[44] King, "Huge Dam Rising to Foil Missouri."
[45] "Garrison Project Statistics," US Army Corps of Engineers, accessed September 17, 2013, http://www.nwo.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/2034/Article/487634/garrison-project-statistics.aspx.
[46] See Robert Bartlett's article on the entire Garrison Diversion Project that included the dam. He notes the nature of how aridity the primary environmental limit in the West has been ignored using technologies, science, and optimism. North Dakotans, according to Bartlett, had essentially failed to adapt to the realities of the West.: Robert V. Bartlett, "Adapt or Get Out: The Garrison Diversion Project and Controversy," *Environmental Review: ER* 12, no. 3 (1988): 57-74.
[47] For more information on the building of the dam and its effect on the local Native Americans, see: Gordon MacGregor, "Attitudes of the Fort Berthold Indians Regarding Removal from the Garrison Reservoir Site and Future Administration of the Reservation," *North Dakota History* (January, 1949): 31-60.; Roy Meyer, "Fort Berthold and the Garrison Dam," *North Dakota History* (Summer and Fall 1968): 220-355.

timberlands that the dam would flood. One last request was to have a bridge built across the reservoir that was going to divide their reservation into three sections. The Secretary of the Interior initially acceded to their demands and even some monetary compensation for the land that would be lost. Soon after, however, the decision was taken out of the Secretary's hands and placed under the will of Colonel Pick who was still brooding over an insult cast at him by a tribal member at an earlier meeting convened to discuss the project. Pick's plan was a hard-nosed denial of all of the conditions requested by the Fort Berthold tribes. The dam took 155,000 acres from the tribes and forced the relocation of 1,700 people. Seventy percent of the tribal cash economy relied on the cattle industry that was devastated by the flooding. Ninety percent of the tribal commercial timber and almost all of their lignite coal resources were also eliminated.[48] The dam has since negatively affected the health and culture of the tribes of Fort Berthold.[49] As Marc Reisner rightly stated, the final insult was naming the reservoir that flooded their lands Lake Sakakawea [Figure 66].[50]

Today, the reservation and its artificial lake sit in the midst of the Bakken boom [Figure 67]. Drill rigs already dot the shoreline of the lake and soon the waters will likely contain wells dipping far below Sakakawea's surface.[51] The waters of the Sakakawea are also in jeopardy from this surge in energy exploitation. At this time, the Army Corps of Engineers who control access to this reservoir have kept drilling interests from extracting

[48] Bernard D. Shanks, "The American Indian and Missouri River Water Developments," Water Resources Bulletin, American Water Resources Association 10, no. 3 (June, 1974): 574-575.; "Dam Water to Evict 300 Indian Families," *The Washington Post*, June 11, 1952.; "Indians Lose Land in Path of Big Dam," *New York Times*, June 11, 1952.
[49] Lisa Jones, "Three Tribes, a Dam and a Diabetes Epidemic," *High Country News*, May 23, 2011.
[50] Marc Reisner, *Cadillac Desert*: *The American West and Its Disappearing Water* (New York: Penguin Books, 1993), 183-191.
[51] Lauren Donovan, "Drilling for oil under Lake Sakakawea," *The Bismarck Tribune*, February 3, 2010.

water from Sakakawea. However, oil and gas companies are allowed to withdraw water from underground aquifers and from the Missouri River.[52] It takes 4 million gallons of fresh water to complete a well in the Bakken.[53] As mentioned above, in a period of 5 years, 4,000 wells were drilled. That is a total of 16 billion gallons of water! In an arid landscape, that is a costly prospect.

Besides bringing costs to bear on the natural resources of North Dakota, the Bakken boom has also continued the legacy of heaping harm upon the Fort Berthold tribes. Greed has thrown the reservation into disarray and many tribal members have been taken advantage of by the oil companies, speculators, and even Tribal leaders.[54] Wells have been drilled across the reservation and will surely continue to be developed into the future. The tribes have, however, begun to take a measure of control from outside influence and have constructed a clean fuels refinery to process the local crude.[55] Perhaps the future will hold promise for the Fort Berthold tribes who were displaced by water but may reclaim their rights through energy. Yet, like all Americans, they face the prospect of climatic changes brought on by the burning of these fossil fuels.

Paleo-Restoration in the Anthropocene

The technofaith that inspired the building of Garrison Dam had its origins in the minds of men like Ferdinand Vandeveer Hayden. Far from being just products of a

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[52] "Facts About North Dakota Fracking & Water Use," North Dakota State Water Commission, February 2014.
[53] Patrick Fridgen, "Abundant Lake Sakakawea Water Becoming Focus for Oil Development," The Oxbow, from the North Dakota State Water Commission, *North Dakota Water* (June 2010): 16-17.
[54] Abrahm Lustgarten, "Feds enabled oil drillers, others to cheat Fort Berthold tribes," *High Country News*, February 25, 2013.; For more information, see: Sierra Crane-Murdoch, "The Other Bakken Boom: A Tribe Atop the Nation's Biggest Oil Play," PERC Case Studies (Bozeman, MT: 2012).
[55] Eloise Ogden, "Work starts at refinery site," *Minot Daily News*, November 15, 2013.

misguided past, paleo-restorative dreams live on today in the minds of men like Marlo Lewis Jr., Center of Energy and Environment Senior Fellow at the Competitive Enterprise Institute, who claimed in 2004, "[f]ar from polluting the planet, CO2 emissions are greening the Earth, enhancing biodiversity and global-food availability."[56] Similarly, Fred Palmer, Senior Vice President of Government Relations at Peabody Energy, "the world's largest private-sector coal company," held an optimistic vision of the consequences.[57] According to Jeff Goodell, during the 1990s Palmer "was one of the most outspoken promoters…[of the idea] that higher levels of CO_2 would lead to a greener, more productive world."[58] Coal, according to Palmer, was "quite literally, a gift from God."[59] In the minds of these two men, burning coal at sites such as Colstrip could help to make a paradise on Earth where lush environments summon images of Cretaceous North America.

When compared to Hayden's and Webb's descriptions of the paleo-restoration of an Edenic West, Palmer's and Lewis' views are hardly new. In fact, the transformations are underway. Recent science suggests that humanity has exited the Holocene and is now entering the Anthropocene Epoch. [60] The massive release of CO_2 through human

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[56] Marlo Lewis Jr., "Carbon dioxide is your friend," October 6, 2004, accessed November 1, 2011, http://cei.org/op-eds-and-articles/carbon-dioxide-your-friend.
[57] Peabody Energy, "About Us," accessed March 29, 2013, http://www.peabodyenergy.com/content/101/About-Us.
[58] "Peabody Energy Profile," last modified July 24, 2011, http://www.peabodyenergy.com/Profile/default.asp.; Goodell, *Big Coal*, 181-182.
[59] Goodell, *Big Coal*, 182.
[60] Naomi Oreskes, "The Scientific Consensus on Climate Change: How Do We Know We're Not Wrong?" in *Climate Change: What it Means for Us, Our Children, and Our Grandchildren*, Joseph F. C. Dimento and Pamela Doughman eds. (Cambridge, MA: The MIT Press, 2007), 93.; Naomi Oreskes and Erik M. Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York: Bloomsbury Press, 2010).; This is not the first time that a unique geological stage has been suggested for humanity. For example as briefly discussed in Chapter 2, see Joseph LeConte's "Psychozoic Era."; Robert Davis, "Inventing the Present: Historical Roots of the

industrial activities since the eighteenth-century has caused a departure from natural climate cycles and has modified diverse ecologies all around the planet.[61] Humans have taken advantage of geologic resources, and if prevailing climate science is reliable, have altered the vast climatological cycles that typically operate on geological time scales.[62] The resources extracted from deep time at sites like Colstrip and the Bakken have underwritten this process. Americans manipulating the remains of ancient ecologies over the past century and a half have contributed to alterations in current day ocean chemistry and geography through acidification, altered marine ecologies, and the opened up the

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Anthropocene," *Earth Sciences History* 30, no. 1 (2011): 63-84.; Joseph LeConte, *Elements of Geology: A Text-Book for Colleges and for the General Reader* (New York: D. Appleton and Company, 1896), 629-646.; Joseph LeConte, "On Critical Periods in the History of the Earth, and Their Relation to Evolution: On the Quaternary as Such a Period," *The American Naturalist* 11, no. 9 (Sep., 1877): 540-557.; H. S. Williams, "The Making of the Geological Time-Scale," *The Journal of Geology* 1, no. 2 (Feb.-Mar., 1893): 180-197.

[61] Will Steffen, Paul J. Crutzen, and John R. McNeill, "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?" *Ambio* 36, no. 8 (December, 2007): 614.; Jan Zalasiewicz, Mark Williams, Will Steffen, Paul Crutzen, "The New World of the Anthropocene," *Environ. Sci. Technol.*, 2010, 44, (7): 2228-2231.; The increasing acceptance of the term can be seen in the recent Geological Society's decision to title its annual conference in 2011, Geological Society of America, "Archean to Anthropocene: The Past is the Key to the Future," accessed October 1, 2011. http://www.geosociety.org/meetings/2011/.; Elizabeth Kolbert, "Enter the Age of the Anthropocene: Age of Man," *National Geographic*, (March, 2011), 60-87.; However, this term has recently been criticized for its abstraction of humanity, inattention to western hegemony and power relations, and its lack of attention to archeological evidence of human-environmental transformations that have been ongoing for thousands of years. For examples of these criticisms see: Michael Balter, "Archaeologists Say the 'Anthropocene' Is Here—but It Began Long Ago," *Science* 340, no. 6130 (2013): 330-36.; Dipesh Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry*, 35 (Winter, 2009): 214, 216, 218, 221.; Mike Davis, "Living on the Ice Shelf: Humanities Meltdown," June 26, 2008, accessed November 1, 2012, http://www.tomdispatch.com/post/174949.; Ben Dibley, ""Nature Is Us:" The Anthropocene and Species-Being," *Transformations*, no. 21 (2012).; Slavoj Žižek, *Living in the End Times* (New York: Verso, 2011).; It should be noted, however, that Paul J. Crutzen, one of the most prominent proponents of the Anthropocene has been an advocate for geoengineering. The Anthropocene can be both a tool for reinforcing the human capacity for controlling the natural world. As much as it can lend humility to human action, it can serve to legitimate the dominance narrative that has been central to our high-energy society.; (James Rodger Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control* (New York: Columbia University Press, 2010), 2.)

[62] Wilfrid Bach, Jürgen Pankrath, and William Kellogg, *Man's Impact on Climate: Proceedings of an International Conference Held in Berlin, June 14-16, 1978*, Developments in Atmospheric Science (New York: Elsevier Scientific Pub., 1979).; IPCC, *Climate Change 2007: Synthesis Report*, accessed March 28, 2013. http://www.ipcc.ch/publications_and_data/publications_and_data.htm.; Spencer R. Weart, *The Discovery of Global Warming* (Cambridge, MA: Harvard University Press, 2008).

Northwest Passage for unhindered travel due to CO_2 emissions and global climate change.[63]

Rising sea levels, like those that inundated North America during the Cretaceous, may now be in the process of returning to the continent. Contemporary artist Alexis Rockman's mural painting *Manifest Destiny* illustrates this potential. Rockman unites the narrative of Manifest Destiny to the predicament of global climate change in depicting Brooklyn submerged and in ruins 3,000 years into the future [Figure 68]. In the eyes of *New York* magazine art reviewer Mark Stevens, "Rockman is delivering a disturbing message about *Homo sapiens'* abuse of the environment. The Manifest Destiny of this immodest species will not be the glorious one envisioned by nineteenth-century Americans, he suggests, but an abandoned, despoiled place."[64] *Manifest Destiny* is a powerful statement reflecting post-industrial anxieties and scorn for an industrial society that is failing to come to grips with its problems and contradictions.[65] It suggests that the burning of fossil fuels (some of which have their origins in the Cretaceous) could help recreate a wet, tropical, and nightmarish simulacrum of Cretaceous North America.

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[63] Alyn C. Duxbury, Alison B. Duxbury, and Keith A. Sverdrup, *An Introduction to the World's Oceans*, Sixth Edition (New York: McGraw Hill Companies, Inc., 2000), 163-166, 203-207.; And a recent ecological analysis of the impact of acidification from emissions by Jerry C. Blackford, "Predicting the impacts of ocean acidification: Challenges from an ecosystem perspective," *Journal of Marine Systems* 81 (2010): 12-18.; John E. Dore, Roger Lukas, Daniel W. Sadler, Matthew J. Church, and David M. Karl, "Physical and biogeochemical modulation of ocean acidification in the central North Pacific," *PNAS* 106, no. 30 (July, 28, 2009).; Legal issues pertaining to the Northwest Passage are examined in Mahealani Krafft, "The Northwest Passage**:** Analysis of the Legal Status and Implications of its Potential Use," *Journal of Maritime Law & Commerce* (October 2009): 537-578.

[64] Mark Stevens, "Boro Hell," *New York Magazine*, May 10, 2004, accessed November 1, 2012, http://nymag.com/nymetro/arts/art/reviews/n_10325/.

[65] Spencer Weart, "Gallery: Spencer Weart on Depicting Global Warming," *Environmental History* 10, no. 4 (Oct., 2005): 770-775.; For a treatment of other artistic renderings of Manifest Destiny see: Roger Cushing Aikin, "Paintings of Manifest Destiny: Mapping the Nation," *American Art* 14, no. 3 (Autumn, 2000): 78-89.

Oddly enough, Anthropocene humans and Cretaceous dinosaurs may end up facing interrelated climatic crises. Some of today's most troubling questions arise when contemporary climate models are pondered in relation to the climatological events and related warming during the late Cretaceous. Paleontologists have hypothesized that the Cretaceous warming period was a component cause for the extinction of the dinosaurs.[66] Cretaceous rocks and fossils hold valuable chemical signatures that lead scientists to initiate profound discussions about the geologic history of the planet as it relates to warming periods. Consequently, the information that these rocks contain is increasingly relevant in the context of the present plight of climate change.[67] By using these products of the Cretaceous, humans are simultaneously becoming geologic agents and comprehending the consequences that such a role entails.

Historians are beginning to accept the anthropogenic geophysical consequences of the industrial world and to consider deep time and the earth's material influence on the human species.[68] The relationship between paleo-environments and western settlement illustrates that a deep history approach is vital to understanding the history of industrial

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[66] Michael D. Lemonick, "The Dinosaur Conspiracy Theory," *Time Magazine*, November 8, 2007, http://www.time.com/time/magazine/article/0,9171,1682273,00.html.; Gerta Keller, "The end-cretaceous mass extinction in the marine realm: year 2000 assessment," *Planetary and Space Science* 49 (2001): 817-330.

[67] Examples of recent scientific literature concerning Cretaceous warming, see: J. Kirk Cochran et. al., "Paleoceanography of the Late Cretaceous (Maastrichtian) WIS of North America: evidence from Sr and O isotopes," *Palaeogeography, Palaeoclimatology, Palaeoecology*, 191 (2003): 45-64.; Erle G. Kauffman, "Paleobiogeography and Evolutionary Response Dynamic in the Cretaceous WIS of North America," *Geological Association of Canada*, Special Paper 27, 1984.; Tim White et. al., "Middle Cretaceous greenhouse hydrologic cycle of North America," *Geology* 29, no. 4 (April 2001): 363-366.; Henning Scholz and Joseph H. Hartman, "Fourier analysis and the extinction of unionoid bivalves near the Cretaceous—Tertiary boundary of Western Interior, USA: Pattern, causes, and ecological significance," *Palaeogeography, Palaeoclimatology, Palaeoecology*, 255 (2007): 48-63.; D.F. Ufnar et. al., "Evidence for increased latent heat transport during the Cretaceous (Albian) greenhouse warming," *Geology* 32, no. 12 (December 2004): 1049-1052.

[68] Chakrabarty, "The Climate of History: Four Theses," 206.; Joshua P. Howe, "History and climate: A road map to humanistic scholarship on climate change," *Climate Change* 105 (2011): 360-361.

America. The narrative of the conquest of nature on which industrial society is built separates humans from the natural world.[69] Deep history unites the history of humanity to the history of the planet. Sites like Colstrip, and many other settlements in the West, would not exist if it were not for the paleo-environments on which they were built. Without recognizing this, we will continue to situate human history in the framework of the conquest of nature and miss the intimate connections between humans and their environment.[70] Deprived of deep history, we will continue to write histories of success or failure in the mastery of nature that downplay the dynamic relationship between Americans and their environment.[71] The history of the West was a geo-evolutionary process between humans and the natural world. If humans are geological agents, it is because we are creatures of the planet's geology.

Narratives of paleo-restoration and technological superiority fashioned from the material remains of the deep past were used for western settlement, dispossession and resource extraction. Through modern geology, ecology, and widespread environmental awareness, scientific and popular narratives are now available to help create stories to override those that had previously thrived in the West. New narratives now flow from scientific studies hypothesizing human-induced climate change produced through fossil-fueled industrialization. It is because of the uneven impact, and economically burdensome nature of abating climate change, that difficult questions of values and

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[69] Carolyn Merchant, *The Death of Nature: Women, Ecology, and the Scientific Revolution* (New York: Harper & Row, 1989).
[70] Andrew Shryock, Daniel Lord Smail, and Timothy K. Earle, *Deep History: The Architecture of Past and Present* (Berkeley, CA: University of California Press, 2011), 8-11.
[71] Edmund Russell, *Evolutionary History: Uniting History and Biology to Understand Life on Earth* (New York: Cambridge University Press, 2011).

morality must bear on the decisions made regarding the politics of climate change.[72] History should play a role in understanding how best to navigate the future through narrating the past industrial America's energetic past. In order to comprehend the morality of this earthly drama, historians are now in a position to produce stories that adequately address the active role as geologic agents that many westerners played over the past two centuries.[73]

The consequences of false visions of inexhaustibility and unbounded faith in progress are evident to all who apply a critical lens of history to the last two hundred years of the planet.[74] Because of the nature of inevitable "normal accidents," it seems the

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[72] Joshua P. Howe, "History and climate," 362.; Joel Wainwright and Geoff Mann, "Climate Leviathan," *Antipode* 45, no. 1 (2013): 1-22.

[73] William Cronon, "A Place for Stories: Nature, History, and Narrative," *The Journal of American History* 78, no. 4 (Mar., 1992): 1347-1376.; Elliot West, "Stories: A Narrative History of the West," *Montana: The Magazine of Western History* 45 (Issue 3): 64-76.; Hayden White, *Metahistory: The Historical Imagination in Nineteenth-Century Europe* (Baltimore, MD: The Johns Hopkins University Press, 1973).; Because science is a social practice, social narratives pervade scientific practice, and in a dialectical manner the science that is created yields newly naturalized narratives. For historical and philosophical scholarship concerning the social construction of science, see: Martin Carrier, Don Howard, and Janet A. Kourany, *The Challenge of the Social and the Pressure of Practice: Science and Values Revisited* (Pittsburgh, PA: University of Pittsburgh Press, 2008).; Martin Curd and J. A. Cover, *Philosophy of Science: The Central Issues* (New York: W.W. Norton, 1998).; John P. Herron, *Science and the Social Good: Nature, Culture, and Community, 1865-1965* (New York: Oxford University Press, 2010).; Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA: Harvard University Press, 1987).; Bruno Latour, *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge, MA: Harvard University Press, 1999).; Donna Haraway, *Simians, Cyborgs and Women: The Reinvention of Nature* (New York: Routledge, 1991).; Martin J. S. Rudwick, *The Great Devonian Controversy: The Shaping of Scientific Knowledge among Gentlemanly Specialists* (Chicago, IL: The University of Chicago Press, 1985).; Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ: Princeton University Press, 1985).; Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago, IL: The University of Chicago Press, 1994).; Steven Shapin, *The Scientific Revolution* (Chicago, IL: The University of Chicago Press, 1996).

[74] David Nye, *Technology Matters: Questions to Live With* (Cambridge, MA: MIT Press, 2006).; Thomas J. Misa, "Retrieving Sociotechnical Change from Technological Determinism," in Merritt Roe Smith and Leo Marx ed., *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge MA: The MIT Press, 1994): 115-142.; John M. Staudenmaier, S.J., "Perils of Progress Talk: Some Historical Considerations," in *Science, Technology, and Social Progress: Research in Technology Studies Volume 2* ed. Steven L. Goldman (Cranbury, NJ: Associated University Press, 1989): 268-293.; For information concerning the problems with weather and climate control technofixes, see: Fleming, *Fixing the Sky.*

height of hubris to believe, as the myths of the industrial progress enables humans to do, that we are not just geological agents, but also geological masters.[75] Mastery of the plains was cultivated by the paleo-restorative dream fostered by geological imaginings of the West, but Americans have learned the limits of that mastery during the Dust Bowl of the 1930s.[76] Humanity should accept another Ancient Greek ideal, that of sophrosyne, the antithesis of hubris. Applying the ideal of sophrosyne can temper the goal of geological mastery with moderation recognizing its limits. The *hubris* of human control over complex envirotechnical systems must be reconsidered through a framework that at once historicizes modern science, and utilizes it to inform our history. Only then can history be used as an effective tool to inform industrial and post-industrial life.

Today, like nineteenth-century scientists, authors and artists such as Rick Bass, John McPhee, Ray Troll and Buff Elting, conjure images of the ancient watery West that are firmly situated in their culture.[77] While these narrative visions are ostensibly benign, progress narratives generated in the West—and built on the geologic history—have altered local and global environments and victimized populations that did not wield industrial energies and have been deprived of social power. It is not simply the visions themselves that do this, but how the visions are interpreted and used to make political decisions. Dystopian environmental prophets like Jared Diamond, Tim Flannery and Bill McKibben, have begun to construct a forceful counter-narrative that admits to

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[75] Perrow, *Normal Accidents.*
[76] Donald Worster, *Dust Bowl: The Southern Plains in the 1930s* (New York: Oxford University Press, 2004).
[77] Rick Bass, *Where the Sea Used to Be* (New York: Houghton Mifflin Company, 1998).; Kirk Johnson and Ray Troll, *Cruisin' the Fossil Freeway: An Epoch Tale of a Scientist and an Artist on the Ultimate 5,000-Mile Paleo Road Trip* (Golden, CO: Fulcrum Publishing, 2007).; John McPhee, *Annals of the Former World* (New York: Farrar, Straus and Giroux, 1998).; Virginia Scharff, "On 'Where the Sea Used to Be'," *Environmental History* 15, no. 2 (April, 2010): 319-323.

undesirable human-induced alterations to the earth.[78] Human history is but a fragment of the history of planet earth, but humanity's diminutive temporal position should not separate it from the deeper history that is responsible for and sustains its existence.[79] Pushing people to think hard about the actual value, in terms of temporal development and environmental impact, of the resources that they utilize is of vital importance to our current environmental crises. To embrace a deeper perspective in historicizing the American West is to help erase the pervasive illusion of inexhaustibility embedded in the transitory fossil fuel regime, which has powered the manufacturing of American progress at significant environmental and social costs. A deep historical outlook can provide a middle road that admits to the beneficial and essential elements of our industrial world, but that also recognizes its flaws and hidden stories.

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[78] Jared Diamond, *Collapse: How Societies Choose to Fail or Succeed* (New York: Viking, 2005).; Tim Flannery, *The Weather Makers: How Man is Changing the Climate and What it Means for Life on Earth* (New York: Atlantic Monthly Press, 2005).; Bill McKibben, *The End of Nature* (New York: Anchor Books, 1989).; Bill McKibben, *Eaarth: Making a Life on a Tough New Planet* (New York: Time Books, 2010).

[79] Alfred W. Crosby, "The Past and Present of Environmental History," *The American Historical Review* 100, no. 4 (Oct., 1995): 1181, 1189.; Alfred W. Crosby, *Children of the Sun: A History of Humanity's Unappeasable Appetite for Energy* (New York: W. W. Norton & Company, 2006).; J. R. McNeill and William H. McNeill, *The Human Web: A Bird's-Eye View of World History* (New York: W. W. Norton & Company, 2003).; J. R. McNeill, *Something New Under the Sun: An Environmental History of the Twentieth-Century World* (New York: W. W. Norton & Company, 2000).; For other examples of energy histories in the *longue duree* see the work of Vaclav Smil: Vaclav Smil, *Energy in Nature and Society: General Energetics of Complex Systems* (Cambridge, MA: The MIT Press, 2008).; Vaclav Smil, *Energy in World History* (Boulder, CO: Westview Press, 1994).

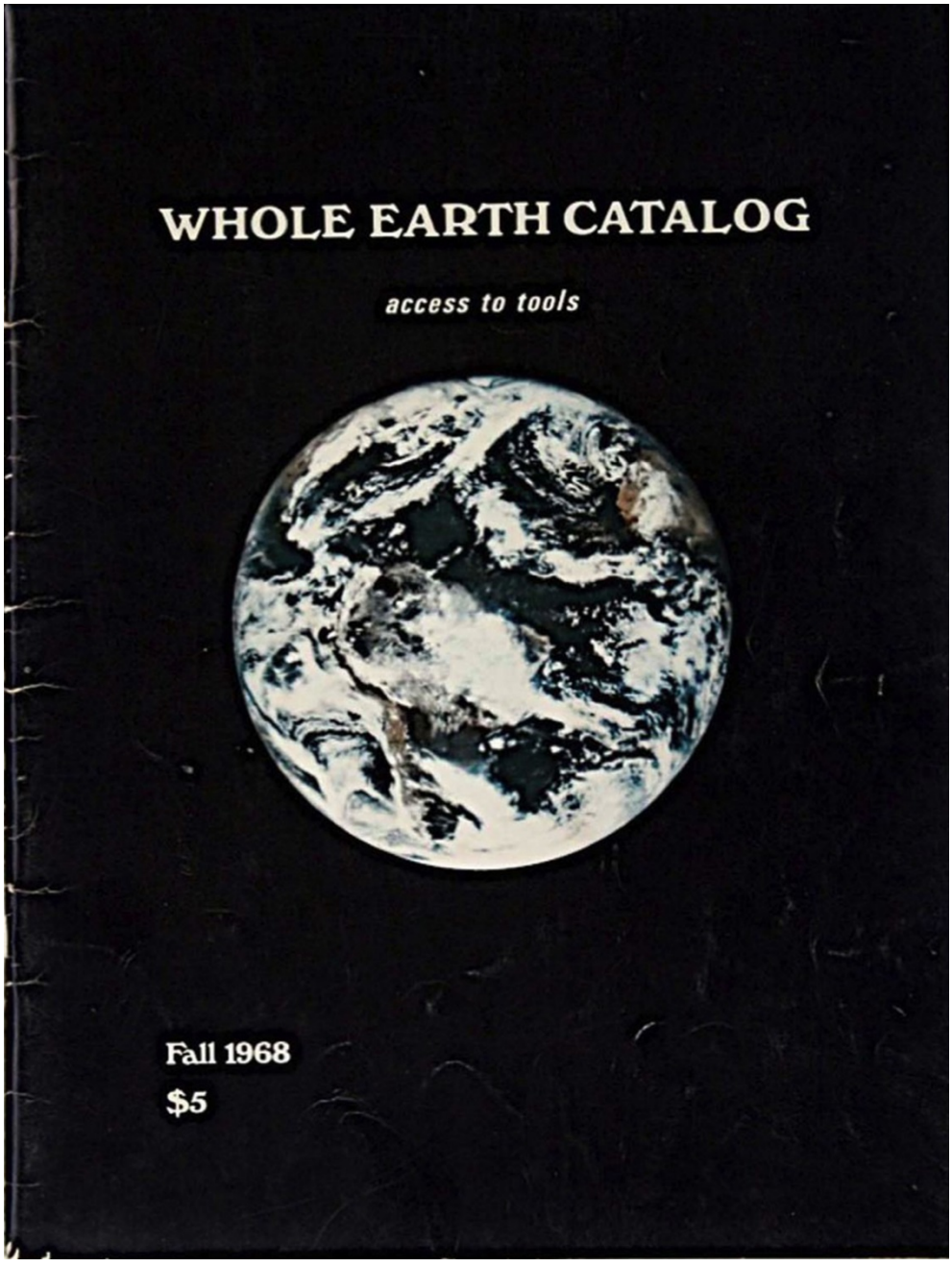


Figure 58. Earth from space. Source: *Whole Earth Catalog*, Fall 1968.

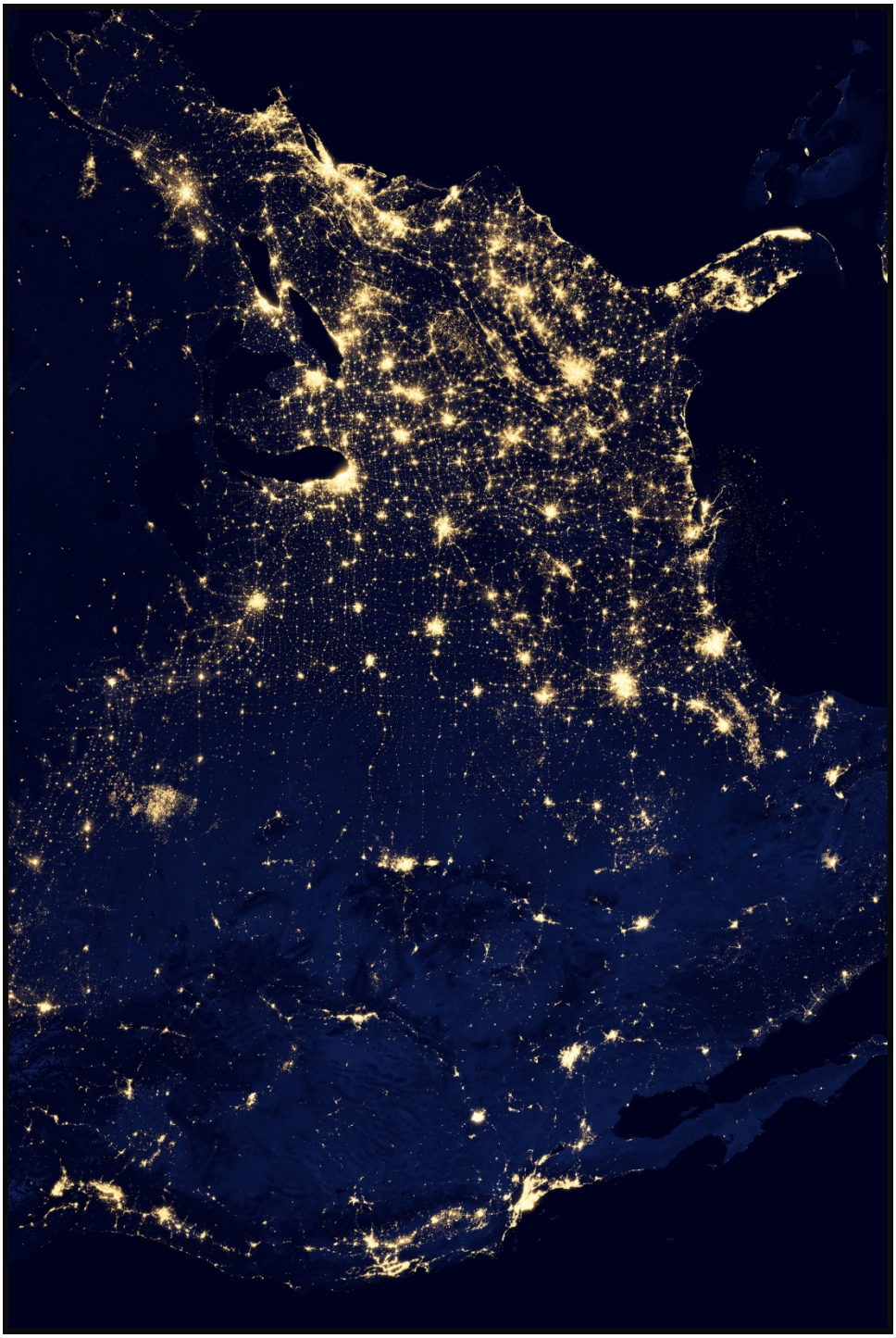


Figure 59. The Black Marble. Source: “City Lights of the United States 2012,” NASA Earth Observatory, accessed June 20, 2014. http://earthobservatory.nasa.gov/IOTD/view.php?id=79800.



Figure 60. Colstrip (1924). Source: “Dobbin, C.E. 163 – Stripping 28-foot coal bed at Colstrip. Rosebud County, Montana. 1924.” USGS Field Notebooks Archive, United States Geological Survey, Denver Library, Denver, CO.

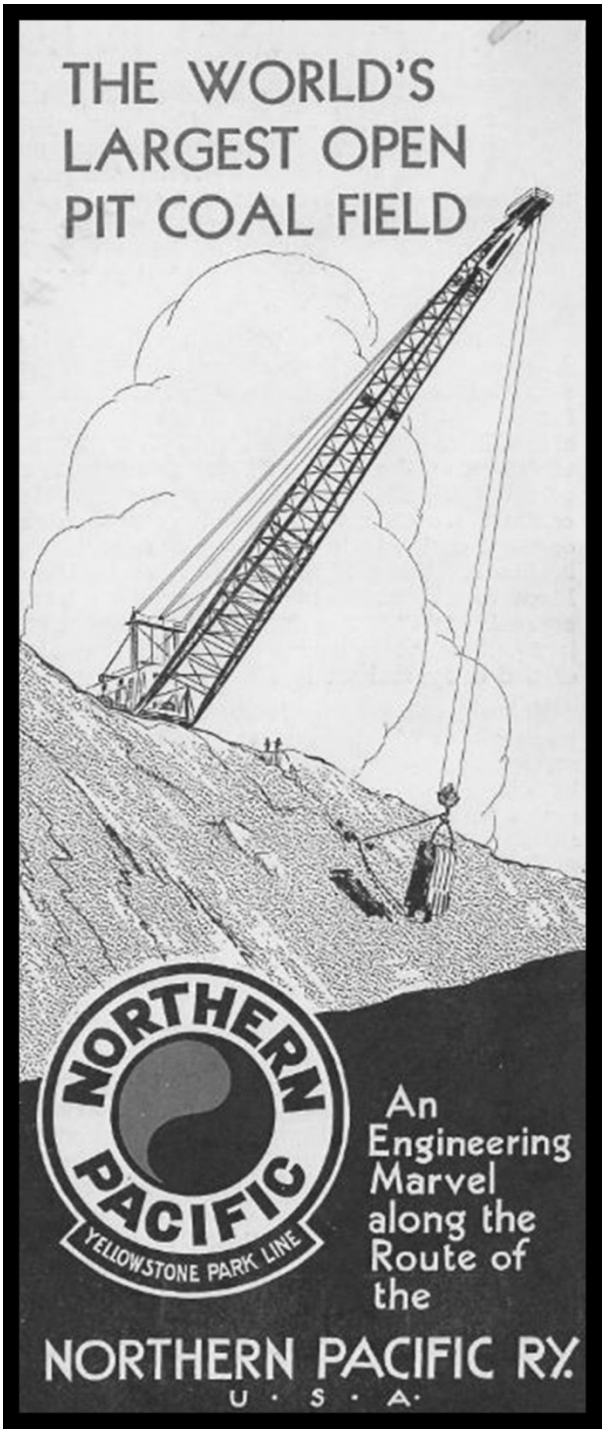


Figure 61. Colstrip (1935). Source: "The World's Largest Open Pit Coal Field: An Engineering Marvel along the Route of the Northern Pacific RY. U.S.A." 134.H.10.6 F, Northern Pacific Railroad Records. Minnesota Historical Society.

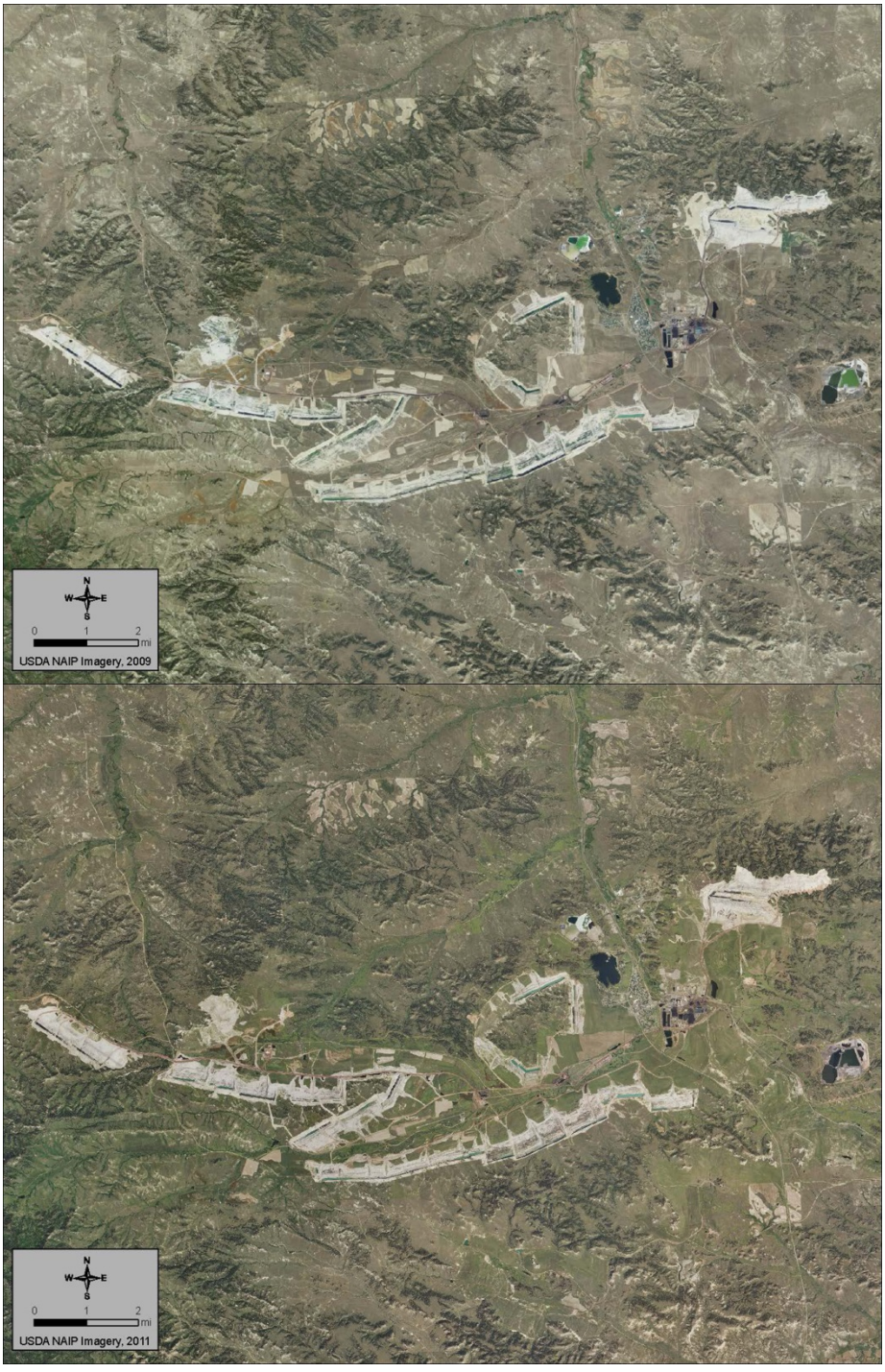


Figure 62. Scars of Colstrip, MT (2009, 2011). Source: Image derived from the National Agricultural Imagery Program (NAIP).

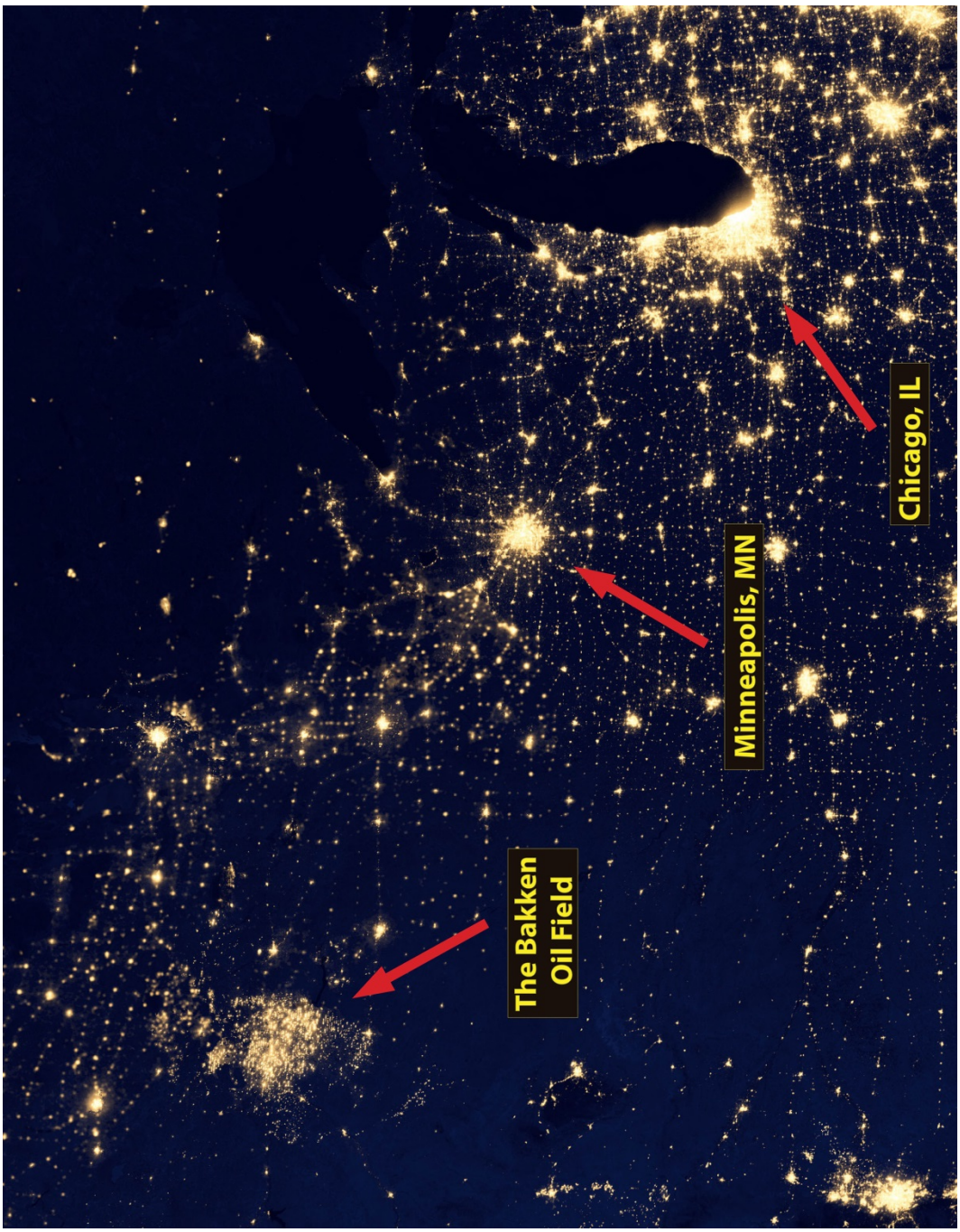


Figure 63. Bakken Flaring Lights. Derived from source: “City Lights of the United States 2012,” NASA Earth Observatory, accessed June 20, 2014. http://earthobservatory.nasa.gov/IOTD/view.php?id=79800.

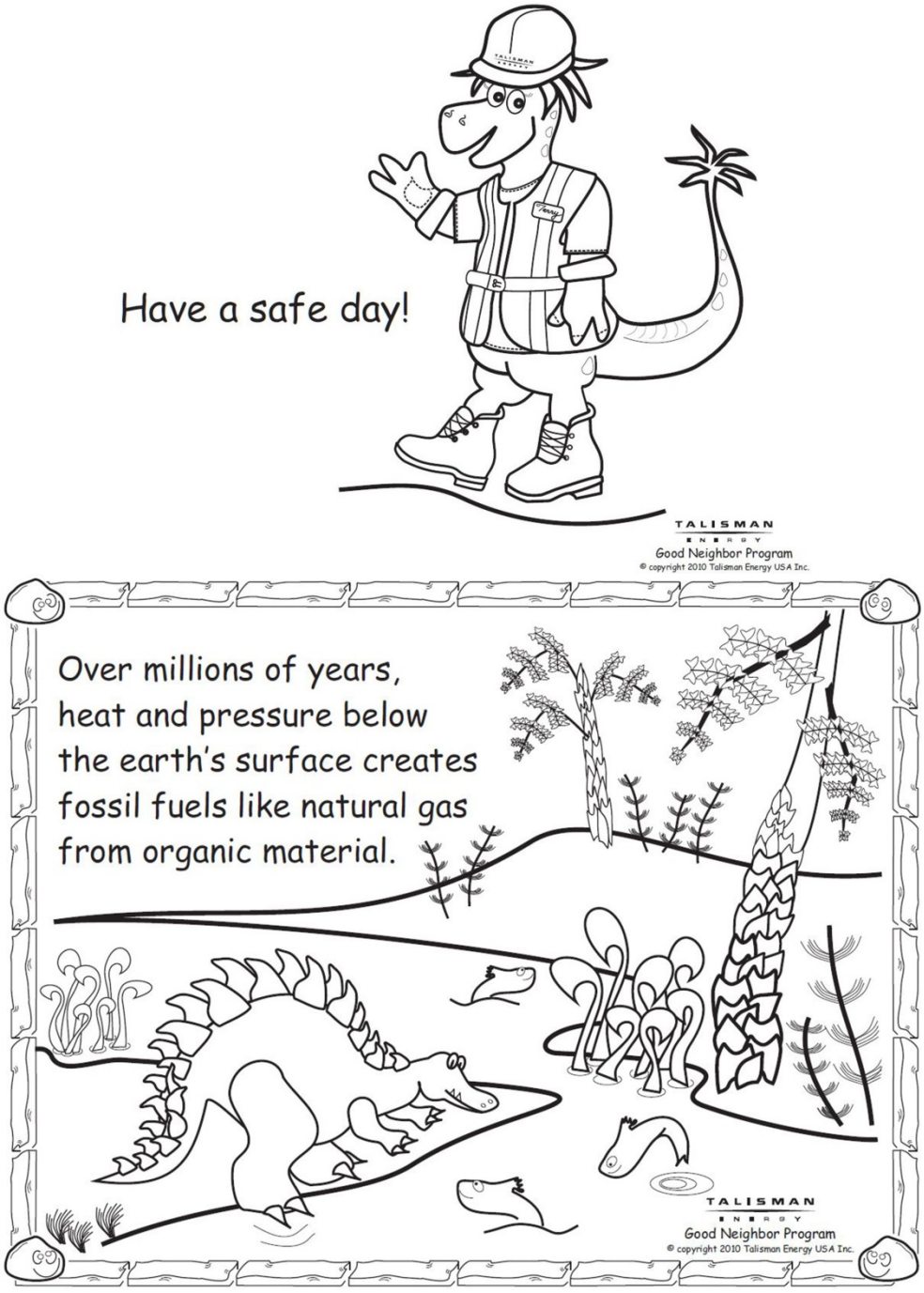


Figure 64. Talisman Terry and his friends. Source: Talisman Energy USA, Inc., "Talisman Terry's Energy Adventure," 2010.



STEGOSAURUS or Spino-Armored Dinosaur who defended himself with the weirdest backbone ever known and possessed a brain in his hindquarters as well as in his head—as he looks to the 1,250,000 people who visit the Sinclair Dinosaur Exhibit at the Chicago World's Fair every month. The Sinclair dinosaurs symbolize the great age of the crude oils from which Sinclair Opaline and Sinclair Pennsylvania Motor Oils are made. A companion product is the new Sinclair H-C Gasoline—higher in anti-knock than the famous Sinclair Stepped-Up 70—and now selling at the price of regular gas.

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Figure 65. Sinclair Dino and the 1933 World's Fair. Source: Advertisement, “Sinclair H-C Gasoline Advertisement,” *The New York Times*, September 28, 1933.

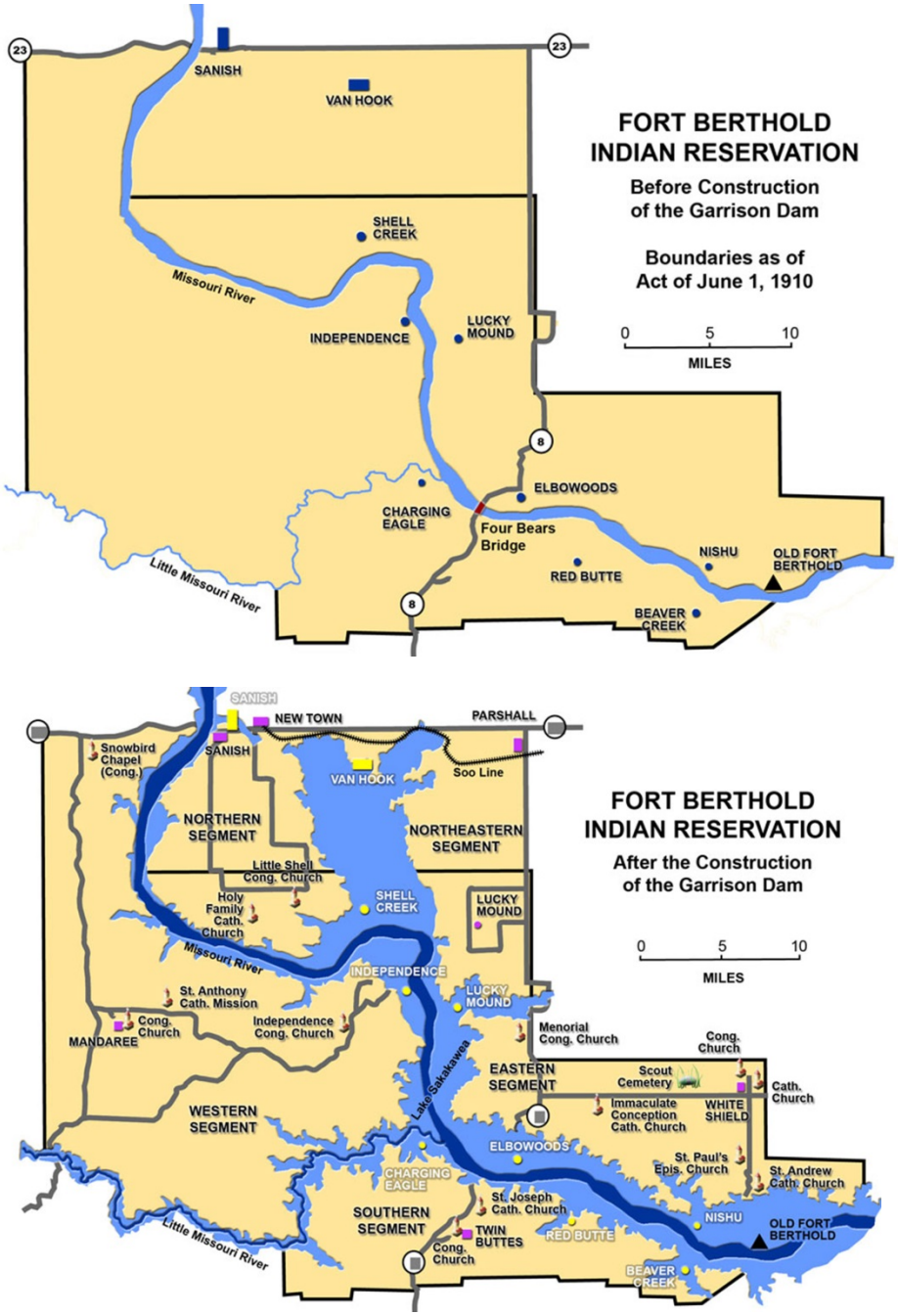


Figure 66. Flooding of Fort Berthold. Source: “Garrison Dam,” Maps by Cassie Theurer, and adapted from Meyers 1977, 193. The History and Culture of the Mandan, Hidatsa, and Sahnish, North Dakota Studies, North Dakota State Government, accessed September 30, 2014. http://www.ndstudies.org/resources/IndianStudies/threeaffiliated/historical_1900s_garrison.html.

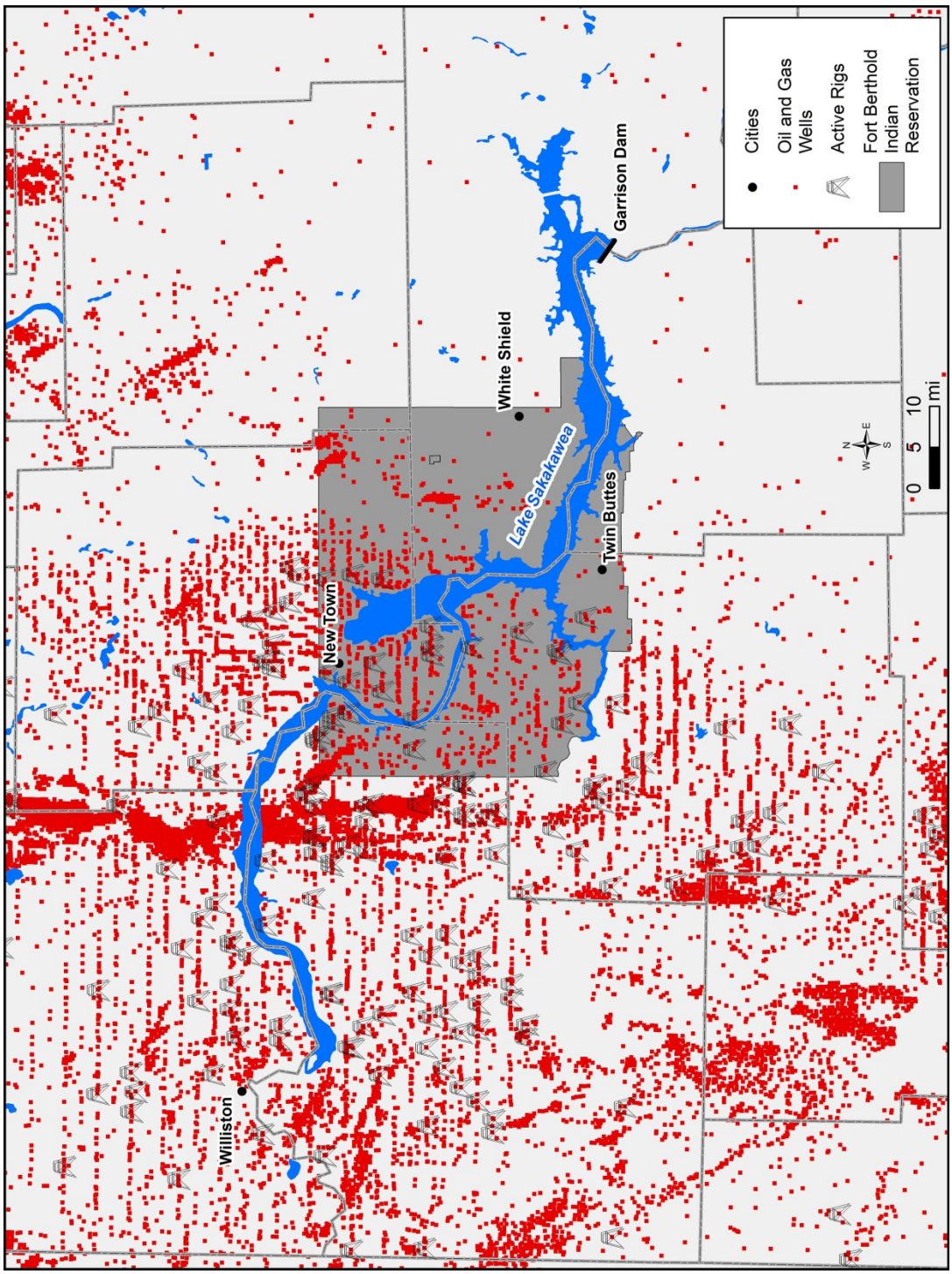


Figure 67. Drilling around Lake Sakakawea and on the Fort Berthold Reservation. Source: Created using ArcGIS by Elizabeth Zizzamia.



Figure 68. “Manifest Destiny,” by Alexis Rockman (2003-2004). Source: Smithsonian American Art Museum and the Renwick Library, ©Alexis Rockman, accessed April 1, 2015. http://americanart.si.edu/images/2011/2011.36A-D_1a.jpg.

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