Science and Technology in American History

To what extent has scientific and technological development served to augment existing structures of power and authority in America? To what extent and in what ways has it undermined those structures or created opportunities for resistance? Examine at least four particular cases, at least one of which should be from before 1850.

Frequently, popular conversations about science and technology turn to terms like “progress” and “efficiency”. Both of those notions require further analysis. In the past, those opposed to a particular use for a technology or avenue of scientific research are framed as a Luddites, someone standing in the way of progress. These accusations generally disregard the social dimensions of science and technology. The conception, development and deployment of any scientific knowledge and any technological innovation emerges from a society, and because that work happens within existing structures of power and authority, more often than not, it works to further support the interests of existing power.

The die are loaded, because existing power and authority guides development and deployment it is quite natural that often technologies work to support existing power structures. However, just as the origin of scientific and technological knowledge is social so is its eventual reception and use. For as long as science and technology has been working to perpetuate the status quo, individuals have subverted it to work against the power structure as well.

This paper intends to help clarify this relationship through four examples of science and technology’s role in American history. Through consideration of 17th century scientific correspondence, the role of technologies in the history of slavery, irrigation technologies in the American west and recent conversations

about information technologies I will point to ways in which science and technology have been used to both support and resist authority and power in American history.

Of Golems and Affordances

Alongside the notion of affordances, Harry Collins and Trevor Pinch's metaphor of science and technology as Hebrew "Golems" offer a fruitful lens to understand how science and technology work. In their presentation science and technology are neither good nor bad but like the golem of Jewish folklore, they are instruments created and designed by people. The golem "will follow orders, do your work, and protect you form the ever threatening enemy. But it is clumsy and dangerous", often leading to unexpected results. The golem itself is not to be blamed; it can be employed to check power or to entrench it. The issue at hand is how a specific science or technology is deployed. [1]

To further refine this notion it is useful to define a bit more about what technologies do. Studies of technology and cognition offer a compelling distinction between what a specific technology or artifact affords users and the use which a specific set of users deploy it to accomplish . For example, I can use a fork as a utensil to eat food. I can use it to scratch out pictograms on a stone. I can use it as a weapon to defend myself. Each of these possibilities exists outside my own ideas about what the fork does, in the artifact itself. With that said, the primary value of defining affordances is to underscore how irrelevant they

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[1] Harry M. Collins and Trevor Pinch, *The Golem: What You Should Know about Science*, 2nd ed. (Cambridge University Press, 1998); Harry Collins and Trevor Pinch, *The Golem at Large: What You Should Know About Technology*, 1st ed. (Cambridge University Press, 2002).

generally are to history. While each of those possibilities is afforded by the artifact, it is generally used in accordance with the social norms that guided its development and use. While a particularly reflective fork could be used as a mirror, largely because the uses of the artifact are socially pre-prescribed, most users won't even consider this as a possibility. In both these cases the notion of affordances and the metaphor of the golem provide a valuable means to separate the potential of a technology or a science from its implementation. [2]

Provincial Science: Leveraging Local Resources for Status: 17th century

American's interested in natural sciences in the 17th century had a unique opportunity. Through correspondence and gift giving aspiring naturalists in the colonies were able to leverage their proximity to objects of scientific curiosity to boost their standing in the scientific community back in London. To give a concrete example consider the relationship between John Bartram, a Pennsylvania Quaker, and Londoner and fellow of the Royal Society, Peter Collinson. Bartram sent Collinson roots, plants and bulbs, and in return Collinson would send Bartram letters of thanks, offer him the title of "King Botanist to the Colonies", and eventually send him a copy of Linnaeus's latest works, which referred to Bartram's contributions by name. The mutually beneficial arrangement gave the provincial Bartram recognition within the most prestigious halls of science, if not as a full member, as an important part in the

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[2] This approach to affordances was first articulated in James Gibson, "The Theory of Affordances," in *Perceiving, Acting, and Knowing: Toward an Ecological Psychology*, ed. Robert Shaw and John Bransford (Lawrence Erlbaum, 1977); and later expanded in James Gibson, *The Ecological Approach to Visual Perception*, 1st ed. (Lawrence Erlbaum, 1979).

production of knowledge. Collinson in turn was ensured a continuous supply of scientific curiosities from the New World.[3]

Some of the most interesting outgrowths of these gifting relationship comes in the ways it offered colonial women similar, albeit circumscribed, opportunities for their own renown within the scientific community. Correspondence between Englishmen and royal society member James Petiver and affluent South Carolina Widow Hannah Williams demonstrates the way in which proximity to objects of scientific curiosity could also transcend social norms governing the relationships of power between men and women. Just as in Bartram's case in return for her work gathering specimens Williams received notice in the *Transactions of the Royal Society*, Petiver even named several species butterfly after her.[4]

The relationships between Bartram and Collinson and Williams and Petiver are representative of the way in which aspiring provincial naturalists could exploit their proximity to natural curiosities of the new world in return for recognition as men and women of curiosity. Joining into the scientific correspondence offered a means for these provincials to raise their status within the structures of power and authority of the scientific community. In this case the empirical focus of Royal Society members, and the affordances of the provincials environment, transferred some power to provincials located near their objects of interest. In this case marginalized individuals were able to use science to acquire their own power.

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[3] Susan Scott Parrish, *American Curiosity: Cultures of Natural History in the Colonial British Atlantic World* (Chapel Hill: University of North Carolina Press, 2006), 172.
[4] Ibid., 194.

Technology and the Creation and Maintenance of a Slave Society

The history of slavery in America has deep connections to technological developments. It is first crucial to recognize different periods of slavery, or as historian Ira Berlin would phrase it, different generations in slavery. As Berlin argues, slavery was made and remade over the course of American history. Agricultural and textile technologies played important roles in that making and remaking, and in that capacity worked to reinforce and further entrench existing systems of power and authority.

To understand the role that agricultural technologies play in shaping slavery it is necessary to understand how slavery before the plantation revolution differed from slavery after. Before the plantation revolution, what Berlin refers to as the charter generation, slaves worked alongside indentured servants. Many of this charter generation eventually won their freedom. Many in this generation sued and were sued in colonial courts, both free and enslaved blacks were able to buy and sell property. [5]

The emergence and success of the plantation system's requirement for more labor, spurred on by the technical developments in large-scale farming of crops like tobacco, worked to significantly depress the relative freedom and rights free and enslaved blacks had found in the charter generations. Eventually in the early 19th century, it was again technical and scientific innovations in agriculture and the creation of the cotton gin that breathed new life into slavery. More than a million slaves were forced in to migration from the seaboard south to the

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[5] Ira Berlin, *Generations of Captivity: A History of African-American Slaves* (Cambridge, Mass: Belknap Press of Harvard University Press, 2003), 36.

southern interior to work in cotton and sugar fields, displacing their ways of life, forcing them into even harder labor then they had endured, and further breaking up family life. Agricultural technologies were crucial components in the creation of a southern slave society and in the continued existence of that system, employed to support the power and authority of slave owners. [6]

Hydraulic Society: 1890-1950

Irrigation projects in the American west offer another place to reflect on the relationship between authority and power, and science and technology in American history. Historian Donald Worster insists the ways in which irrigation technology was deployed in the American West created a *Hydraulic Society* where large scale manipulation of water in an arid settings worked to support the interests of a power elite.

His argument is well supported by examples from the rural west. The repeated deployment of federal funds to benefit elite members of that society underscores the ways in which technologies like irrigation can take away basic assets many American's take for granted. In an arid environment, water becomes a scarce commodity and the money required to sustain the development of water projects, at least in this situation, worked to reinforce the power and authority of elites, and the scientific managers gave that power the clout of reason and efficiency.[7]

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[6] Ibid., 161-162.
[7] Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West*, 1st ed. (New York: Pantheon Books, 1985), 210-212.

While irrigation technology worked to create and reinforce elite power in the rural west, the same technologies worked in a decidedly different fashion in the urban West. When William Mulholland arrived in Los Angeles in 1878 it was "a pueblo of 9,000 souls". In his 40 years of public services he dramatically shaped the landscape and his water developments clearly played a role in the city's population explosion.[8] While Worster insists that water projects in the west worked to the advantage of large scale farmers at the loss of smaller farmers for the people of Los Angeles irrigation projects that brought water to the city meant water for everyone. While it is true that the wealthy received water and plumbing well before the rest of the city's residents the water did eventually come to most residents.

The difference between the power dynamics of this single technology in an urban and rural setting underscore a repeating theme. In these cases technologies do not come with defacto political implications. The irrigation projects afforded multiple outcomes, they could work to bring water to a multitude of people or to hoard water for an elite. In either case the implications for the technology were shaped by social, political and economic circumstances in which they were deployed.

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[8] Catherine Mulholland, *William Mulholland and the Rise of Los Angeles* (Berkeley: University of California Press, 2000), 14. Although it is clear that Catherine Mulholland has an agenda, the rehabilitation of her father's legacy, she does offer a wealth of solid factual information the work does offer a generally accurate description of William Mulholland's career.

Classroom Computing: Oversold, Underused, and Deeply Misunderstood

The history of educational technology is rife with hyperbole and overselling new technologies. Radio and film have each had their educational booms and busts and for the last twenty years computers and information technology have been the primary subjects for educational technologies next best thing to revolutionize education and give power to the powerless. Much of the initial hype for information technologies focused on getting computers into schools, but without teachers adept in their use it should not be too much of a surprise to find that physical proximity to computers alone fails to empower students.

By the mid-nineties the Clinton administration had brought a new term into the lexicon. The problem was that there was a "digital divide," along race and class lines, whereby wealthy white students were benefiting from information technology while minority and lower class children were, still in many cases, computer literate. While there were calls for more sophisticated understanding of the role of training and support for teachers most of the fervor surrounding the digital divide translated into putting more computers in low-income schools, not in teacher training, or addressing deeper fundamental issues with equity in education. This same pattern is evident in the recent one laptop per child campaign developed by MIT. Enthusiasm for the technological object, making laptops for about a hundred dollars a piece, glossed over the fact that people need training to use them.

In reaction to the boom in thinking on this matter there has strong countervailing bust. Many scholars now propose the complete opposite, that

these so-called revolutionary information technologies are a complete distraction.[9] Both sides of these arguments fail to appreciate their belief in notion that the technologies come prepackaged with impacts. Computer boosters have and continue to insist that revolutionary information technologies like computers and the internet will inevitably shift the balance of power, giving the disenfranchised easy access to knowledge and power. At the same time their critics insistence that the technologies will not have such an impact come from the same kind of beliefs, that these technologies come with defacto implications. Yet just because information technologies have not brought about widespread changes in power relations does not mean that they could not be used to do so if the social environment they were deployed into were altered.

Conclusions:

These four stories, 17th century scientific correspondence, the role of technologies in the history of slavery, irrigation technologies in the American west and recent conversations about information technologies are each very different however there are a few general themes. First, it should be clear that it is impossible to weigh the good and the bad which science and technology has been used to create. Second, in each of these cases the implications of these technologies were not forgone conclusions. In each case the capabilities afforded by the given science or technology were utilized by different actors based on their understanding of the value and use of the given technology.

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[9] For examples of this reactionary take on information technology see Larry Cuban, *Oversold and Underused: Computers in the Classroom* (Harvard University Press, 2003); Daniel Lee Kleiman, *Science and Technology in Society: From Biotechnology to the Internet* (Wiley-Blackwell, 2005), 34-49.

Bibliography:

Berlin, Ira. *Generations of Captivity: A History of African-American Slaves*. Cambridge, Mass: Belknap Press of Harvard University Press, 2003.

Collins, Harry, and Trevor Pinch. *The Golem at Large: What You Should Know About Technology*. 1st ed. Cambridge University Press, 2002.

Collins, Harry M., and Trevor Pinch. *The Golem: What You Should Know about Science*. 2nd ed. Cambridge University Press, 1998.

Cuban, Larry. *Oversold and Underused: Computers in the Classroom*. Harvard University Press, 2003.

Gibson, James. "The Theory of Affordances." In *Perceiving, Acting, and Knowing: Toward an Ecological Psychology*, edited by Robert Shaw and John Bransford. Lawrence Erlbaum, 1977.

Gibson, James J. *The Ecological Approach to Visual Perception*. 1st ed. Lawrence Erlbaum, 1979.

Kleiman, Daniel Lee. *Science and Technology in Society: From Biotechnology to the Internet*. Wiley-Blackwell, 2005.

Mulholland, Catherine. *William Mulholland and the Rise of Los Angeles*. Berkeley: University of California Press, 2000.

Parrish, Susan Scott. *American Curiosity: Cultures of Natural History in the Colonial British Atlantic World*. Chapel Hill: University of North Carolina Press, 2006.

Worster, Donald. *Rivers of Empire: Water, Aridity, and the Growth of the American West*. 1st ed. New York: Pantheon Books, 1985.

Westward Movement in American History

The westward expansion of Euro-American settlement is one of the most important features of American history from the seventeenth to the twentieth centuries. How would you periodize the history of this westward expansion, and why? What were the most important eras in this history, what were the main characteristics of each era, and what were the major turning points in shifting from one era to the next?

Though historians might wish otherwise, the "frontier thesis" remains a vital, go-to historical theory for explaining westward movement in American history.[10] For Turner, the history of American expansion is primarily a story of successive frontiers. In some ways it is more of a process than a peridozation. In the first stage, people leave their existing society to build up a new one in the openness of successive frontiers. While this model leaves much to be desired in its simplification it does provide a starting point for examining the westward expansion of Euro-American society.

Instead of focusing on a particular periodization based on different bands of years it is much more fruitful to think of Euro-American westward expansion from the seventeenth to the twentieth centuries as a process that repeats in stages. For the most part, I agree with Historian Stephen Aron that the story of the American West, and to some extent the larger story of American history is "conquest, colonization, and capitalist consolidation of the continent, which under the republic moved from east to west."[11] I would add three caveats. First, before conquest comes a period of "middle ground" where indigenous peoples and Euro-American's are forced into a form of comparative peacefulness and cultural exchange. Second, I beg to differ on the point of "capitalist

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[10] White and Newberry Library, *The Frontier in American Culture*, 3.
[11] Aron, "Lessons in Conquest."

consolidation". If anything, the final stage has more to do with federal dependence. Finally, this story of conquest, colonization, and consolidation skips the opportunities for social mobility that westward expansion offered some Americans.

Middle Ground:

Richard White's notion of middle ground is a fruitful way to conceptualize the first phase of each push for westward American expansion. Through his study of the *pays d'en haut* greater Great Lakes Region, from 1650 to 1815 he conceptualizes a powerful approach to understanding cultural contact. In his view, the middle ground is both a specific place and a more abstract space where divergent groups of individuals accommodate to each other, largely through misunderstandings, allows White to write a different kind of history of American Indians. It also gives us a powerful framework for thinking about any of these border, frontier, places of cultural exchange.

Instead of this book being about a clash of cultures it is instead a history of the creation of cultures. The story focuses on the constantly shifting landscape of the region. For example the first chapter traces the role of the Iroquois in early European Indian encounters. As the Iroquois initiate conflict with Algonquin groups the Algonquians coalesce in refugee camps which give them a base to gather support from French traders, and missionaries. Ultimately giving the Algonquians a way to come together to force out the Iroquois. With the Iroquois

gone the Algonquians can now spread out, "declining the very communities that had produced the Alliance."[12]

The middle ground is forged in part because neither side had the power to overtake the other. Instead they were forced to accommodate each other. Through Marriage and trade these two peoples negotiated their ideas of each other and ultimately constructed a culture that was different from either of their original worlds.

Kupperman's argument in *Indians and English* about an earlier period parallels and extends Richard White's idea of the middle ground. Central to both White and Kupperman's accounts is an emphasis on agency in the hands of native peoples. In this approach to the history of these encounters there is a period of cultural exchange and dynamism that occurs, one which should not be forgotten because of the eventual destruction of many of these ways of life and peoples.

Throughout Kupperman's narrative one of the most salient points is the notion that innate radicalization of natives is not readily apparent in the writings of Europeans who had contact with Natives. The most compelling evidence here is found in the ways Natives were presented as physically similar to Europeans in popular images. Similarly, in this early period, intermarriage was a question open to debate, as evidenced by Pocahontas's marriage.

Altogether the book is quite successful in reframing discussions about early interaction between Indians and English. Kupperman offers a successful

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[12] White, *The Middle Ground*, 49.

challenge to prevailing ideas that European society simply steamrolled Native societies. Instead, it is clear that the interactions between these two cultures were transformative in both directions, just as the Indians understood the English through their own experiences so did the English understand the Indians.

As westward expansion accelerates, middle ground negotiations require a smaller and smaller phase in the story. The racialization of native peoples combined with the continually growing imbalance of power between native peoples and euro-Americans forces the Conquest and colonization phase of Westward movement much move quickly.

Conquest and Colonization

After a middle ground period of forced cultural conversation each phase of westward expansion has resulted in forms of conquest over indigenous peoples and colonization of their lands. While each expanding zone of conquest and colonization happened in different contexts and spaces there are some general trends to them. It is worth noting that this is a distinct departure from Fredrick Jackson Turner's approach to the west as empty wilderness. The historical frontier was a place teaming with conflict in which indigenous peoples were systematically whipped out over the course of several hundred years as European-Americans replaced them. Whether it be the Pequot War in 1630's New England, the fate of the Algonquin peoples at the end of the war of 1812, or

war with the Sioux in the 1840's the middle ground of cultural came to an end in conquest and violence.[13]

In each of these steps, colonization came hand in hand with conquest. The migration of peoples responsible for this colonization has its root in patterns of migration found in England even before the start of widespread immigration to the new world.[14] The same desire for better opportunities for social mobility pushed colonists to risk everything to leave their lives and move to each of these new frontiers. Here is a point at which Turner's thesis is successful, the overarching narrative of the frontier as a catalyst for social mobility and adventure does hold some historical weight, but it must simultaneously be tempered with consideration of the violent conquest involved in large scale destruction of existing patterns of indigenous societies.

Over the course of those conquests the tenor and nature of that movement changed. By the time Turner articulated his theory for westward expansion in 1893 the racalization of American Indians had shifted them from status as people into a different category. One can find evidence of this transformation in maps. The 1718 *Carte de la Louisiane et du Cours du Mississipi* shows a map filled with peoples, individual tribes are named in the same pen strokes as those for European towns across the continent. In contrast, the eighth map which accompanies Emma Willard's 1828 *History of the United States, or Republic of America* shows nearly complete emptiness beyond the boarders of the United

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[13] Kupperman, *Indians and English*, 228-229; White, *The Middle Ground*, 516-517; White, "The Winning of the West."
[14] Games, *Migration and the Origins of the English Atlantic World*, 41.

States. By 1828 the kinds settlements indigenous peoples made in the Americas were not even to be represented as comparable spaces on American maps. [15]

The explanation for this shift can be found in developing notions of race. Earlier, in the 17th century enlightenment philosophy had supported and defended the fundamental unity of mankind.[16] Much of early Indian policy was grounded in these values, in the opportunities for native peoples to become "civilized". However, by the 1815 to 1830's Indian removal policies had become more than rejection of the Indians that would not cooperate with plans for integration with Euro-American society, it had become a rejection of all Indians.[17] In the earlier periods of conquest Euro-American's had seen their opponents as peoples but by the end, even according to their maps, through scientific approaches to race Euro-Americans had demoted indigenous Americans to a people incapable of civilization.

As colonization advanced in each of these periods a new force came to bear. The romantic west, of lone cowboys on the open range is at best a short lived historic period and at worst a complete fantasy. On the heels of conquest came colonization and on the heels of colonization came various systems of social control in the form of capitol, consolidation, and comodification.

Control: Capital, Consolidation and Comodification

The notion of the lone cowboy on the ranch belies the nature of his work. As those cowboys drove cattle toward central locations to be moved to stockyards

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[15] White and Newberry Library, *The Frontier in American Culture*, 18-19.
[16] Horsman, *Race and Manifest Destiny*, 46.
[17] Ibid., 192.

in places like Chicago those cowboys were already participating directly in the simultaneous process of capitalist consolidation and comodification. One of the best examples of this process is the history of the city of Chicago itself. The emergence of the commodities market, extensive logging in Wisconsin, and the growth of the stockyards all contributed to a strong link between the wide open spaces that populate popular conception of the western frontier and cities, exemplified by Chicago, which translated the work in those spaces, clear cutting, ranching, and agriculture, into goods for the market place. Some of the most compelling evidence for these bonds and interconnection can be seen in maps historian William Cronon developed of counties throughout the Midwest's shares of Midwestern debt. Each of the emerging cities, places like Milwaukee, Minneapolis, Omaha, Kansas City, and St. Louis, had clearly visible debt hinterlands: surrounding rural areas where people were most likely to owe money to creditors in that particular city. As the farmers and ranchers colonized the land of indigenous peoples they simultaneously brought with and became part of the emerging market revolution. Westward expansion was as much about the freedom of the wilderness as it was about the market bonds between that wilderness and interconnected metropolises.[18]

The increasing comodification and its connection to capitol was not the only force for consolidation in the American west. Another often forgotten story in the history of the west is the story of the federal west. While the city of Chicago was emerging as a hub to the market for western expansion in the mid 19th

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[18] Cronon, *Nature's Metropolis*, 284-292.

century irrigation projects in the inner mountain and desert West along the Colorado river were well on their way toward a variety of expensive irrigation projects. In 1879 and 1881 the congressional irrigation acts made those projects part of national interest. While western states might try to portray themselves as rugged individualist, the evidence demonstrates that there is no denying of the long history of Federal support and involvement. [19]

As the federal government expanded and grew over the course of American history it entered into very different relationships with the states that emerged over the course of its different periods. Declarations that the rivers of the west were, in some sense, public property would not have been possible to the same extent in the older parts of the country which had older entrenched powers of their own. This federal story continues into the 20th century. As historian Roger Lotchin documents in *Fortress California* the western strategy for wedding the success of California to investment from the federal government pays off big.

Conclusion:

Rather than completely rejecting Turner's ideas, I argue that his approach offers a fair amount of value. First, Turner's idea of the frontier as a process instead of a strict periodization, is fruitful. His ideas about the role the west played for colonists, as a place of opportunity and vitality, still holds a bit of value in working with the reasons for westward movement. With that said, historiography of the west has a considerable amount to offer in refining this notion. The most crucial improvement is recognition of the role indigenous

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[19] Worster, *Rivers of Empire*, 94-95.

peoples played and currently play in the west. The middle ground gives proper emphasis to the rich history of first encounters and interactions between peoples, and a focus on conquest then gives equal time to both conqueror and conquered. The second major feature that changes Turner's view is the role of consolidation of power in the west. Whether it is the capitalist west or the federal west visions of the lonely frontier are clearly outgrowths of longing and imagination instead of historical fact.

Bibliography

Aron, Stephen. "Lessons in Conquest: Towards a Greater Western History." *The Pacific Historical Review* 63, no. 2 (May 1994): 125-147.

Cronon, William. *Nature's Metropolis: Chicago and the Great West*. 1st ed. New York: W. W. Norton, 1991.

Games, Alison. *Migration and the Origins of the English Atlantic World*. Harvard historical studies v. 133. Cambridge, Mass: Harvard University Press, 1999.

Horsman, Reginald. *Race and Manifest Destiny: The Origins of American Racial Anglo-saxonism*. Cambridge, Mass: Harvard University Press, 1981.

Kupperman, Karen Ordahl. *Indians and English: Facing Off in Early America*. Ithaca, N.Y: Cornell University Press, 2000.

Lotchin, Roger W. *Fortress California, 1910-1961: From Warfare to Welfare*. Urbana, IL: University of Illinois Press, 2002.

White, Richard. *The Middle Ground: Indians, Empires, and Republics in the Great Lakes Region, 1650-1815*. Cambridge studies in North American Indian history. Cambridge: Cambridge University Press, 1991.

---. “The Winning of the West: The Expansion of the Western Sioux in the Eighteenth and Nineteenth Centuries.” *The Journal of American History* 65, no. 2 (September 1978): 319-343.

White, Richard, and Newberry Library. *The Frontier in American Culture: An Exhibition at the Newberry Library, August 26, 1994 - January 7, 1995*. Chicago: The Library, 1994.

Worster, Donald. *Rivers of Empire: Water, Aridity, and the Growth of the American West*. 1st ed. New York: Pantheon Books, 1985.