Preface

PLAYING POWER LINES

> Two endless parallel lines in swift longitudinal motion . . . occupied the whole field. There were present no dreams or visions in any way connected with human affairs, no ideas or impressions akin to anything in past experience, no emotions, of course no idea of personality. There was no conception as to what being it was that was regarding the two lines, or that there existed any such thing as such a being; the lines and waves were all.
>
> —Qtd. in William James, *The Principles of Psychology*, 1890

PLAY. When I was five years old, I began to play an imaginary video game called "power lines." I played power lines as the family station wagon glided along the tree-lined, four-lane avenues of Omaha, Nebraska, and as it zipped down bucolic two-lane highways. The game's invisible avatar, my "guy," had short black hair, blue jeans, sturdy legs, and lightning-fast steps. The wagon's movement initiated the action: I locked eyes on the line, mentally pressed PLAY, and guy materialized. Guy made simple, acrobatic maneuvers. He could "run" on top of the lines, "jump" sideways between parallel lines, and "super jump!" over the tops of wooden poles, steel tubes, or lattice towers. In those early years the make-believe game was likely inspired by the undulating actions of digital avatars in real video games like *Super Mario Bros.*, *Sonic the Hedgehog*, and *Contra*. I did not memorize levels nor commit controller buttons to muscle memory, but hours of watching my friends play these games sank the digital rhythms into my brain. Similar patterns were then projected onto the lines in the landscape.

Playing my self-invented power lines game satisfied some nebulous desire for order. The spindly lines and jumping courses could be traced, plotted, and rearranged like the green, pink, and yellow ceramic tiles on the bathroom floor or the wooden beams on the church ceiling. Other shapes and movements focused my attention and brightened my eyes—the leather basketball's spinning ribs splashing through a white nylon net is also fixed in my memory. Yet I found myself routinely hypnotized, staring through the window, fixated on the lines that seemed to gallop above the traffic. Looking back, my experience with these real lines resembled an ether-induced vision reported by a Dr. Shoemaker of Philadelphia and repeated by William James: "There was no conception as to what being it was that was regarding the two lines, or that there existed any such thing as such a being; the lines and waves were all."[1] For miles, it seemed, I disappeared; the power lines were all. Sometimes guy followed me, as if the original game was reengineered everywhere we happened to travel.

Into my teens I habitually followed the syncopated swoops across the Great Plains. In these agricultural regions power lines, water towers, and grain silos often visually dominate rolling farmlands and pastures. In my twenties I toured the continent by car, bus, and motorcycle. Romance and randomness inspired most of these road trips, and my mental maneuverings of the black-haired guy faded. Nevertheless, power lines frequently drew my attention roadside. In Utah I registered the sinewy sines and cosines shimmering through the salt flats; I popped the throttle in Montana, and, with a faint beat pounding inside my helmet, I marched in step with anthropomorphic, transformers-like towers; as the Greyhound crossed Kentucky, I let my sight get stitched by the electric looms hanging over the rectangular horse fences; on the Jersey Turnpike I felt lost amid endless electric spools and faceless faux totem poles lined up near the Thomas Edison Service Plaza. The travel modes, backdrops, and systems of imagery constantly changed—the optical attraction to those rippling forms on the fringes remained.

My youthful play of the power lines game came flooding back in the autumn of 2006. I was sitting in the Main Reading Room of the New York Public Library reading Jonathan Edward's "Spider Letter." In 1723, at the age

of twenty, Edwards composed a scientific account of how spiders loosened draglines from their bodies and used them to float across the canopy of Connecticut. Edwards's letter includes hand-drawn diagrams detailing the spiders' ingenious combination of silk threads, gentle breeze, leverage, and buoyancy. Recently, scientists found that spiders can detect and respond to electric fields in the atmosphere and that they use electrostatic forces to help them fly, or "balloon," over significant distances.[2] Edwards was excited by flying behaviors he carefully observed and documented, but he was unaware of their actual electric potential. For him the magnificent "spiders that make those curious, network, polygonal webs" further proved the wisdom of the Creator's design.[3] While sunlight from Bryant Park poured through arched windows into the Reading Room, I read about a teenage Puritan adjusting his eyes to sunbeams reflecting spider silk in the forest.

PAUSE. I leaned back in the wooden chair, looked up, and watched an invisible thread swing from a chandelier's exposed bulb to a golden plaster rosette on the edge of the painted blue sky. Suddenly, I could see the three silver wires above Blondo Street. Nearly seventy-feet in the air, the wires attached to the wooden pole in a "wishbone" arrangement of angled crossbeams (fig 1). I then recalled the feeling of running and jumping lines dilating and constricting above the station wagon window. Edwards, a young boy who watched spiders fly through the forest and grew up to deliver Early America's most famous fire-and-brimstone sermon, "Sinners in the Hands of an Angry God," had jostled from memory the imaginary video game I played in Nebraska in the 1980s.

NEW GAME. After ruminating on my boyhood play with power lines, I composed an essay connecting Edwards's flying spiders to Ralph Waldo Emerson's "great principle of Undulation in nature" and his vision of the world as "the flux of matter over the wires of thought."[4] To the original link from Edwards to Emerson, I added analysis of two fictional portrayals of undulating lines. In James Joyce's *Portrait of the Artist as a Young Man* (1916) Stephen Dedalus stares out a train window in Ireland and begins to form a prayer. The prayer begins as "a trail of foolish words which he made fit the insistent rhythm of the train." The mix of words and train rhythm is then mapped onto the passing landscape as "silently, at intervals of four seconds,

1. 69kV transmission line, 2018. The three slanted arms attached to the pole form what some utility line workers call a "wishbone" configuration. I began the imaginary "power lines" game at this corner of Blondo and 102nd Street in Omaha, Nebraska. Photo by Eva Hernandez.

the telegraph poles held the galloping notes of the music between punctual bars."[5] Similarly, in Vladimir Nabokov's short story "A Matter of Chance," first published in Russian in 1924, the movement of the wires outside the Berlin-Paris express train reflects a hopeless dining car attendant's mood swings. First, the "even row of telegraph wires could be seen swooping upward," then "a telegraph pole, black against the sunset, flew past, interrupting the smooth assent of the wires." Outside the window the wires, expectedly, "dropped as a flag drops when the wind stops blowing. Then furtively they began rising again."[6] The cadence of the rising and falling lines posted alongside train tracks, I argued, had been reflected in, and possibly an inspiration for,

these authors' development of the narrative mode named stream of consciousness. The clean, repetitious undulations in the landscape provided a counterbalance to the narrator's more jumbled, sometimes chaotic thoughts. The perceptions of telegraph lines modeled a somewhat accidental and yet easily identifiable feeling of order. Stephen and the suicidal attendant each desperately sought to latch onto such feelings and the accompanying forms. The loose connections between Edwards and three literary giants—Emerson, Joyce, and Nabokov—marked the beginning of a new game. A series of conceptual jumps and archival sidetracks related to telegraph lines began to dominate my research, writing, and figurative power lines play.

In the years following that Reading Room realization, I began to explore telegraph lines as material and metaphorical conductors of nineteenth-century landscapes. Drawing from a range of relatively static texts and images, I argued that the electric telegraph, and its lines, occupied the razor's edge between science and spirituality, technology and progress. My subjects felt simultaneously unified and polarized: electricity and landscape, power and lines, function and form. With these groupings as my guidelines, I made gentle swoops from the first system (electricity, power, and function) to the other (landscape, lines, and form). I learned that telegraph lines initiated the basic patterns by which electric networks permeated American culture and that their presence in the material landscape also challenged the values that Emerson and others of the American Renaissance attributed to the raw, sudden, electrifying experience of nature. The project showed the diverse iconography of American landscape intersecting with the material and cultural changes wrought by telegraph lines.

Over time I expanded my study beyond the framing of electric landscapes performed in nineteenth-century essays, novels, newspapers, poems, and paintings. On the one side my new research engaged a broader range of "electric" texts, including classic films, utility advertising campaigns, industrial design projects, and made-for-television movies. On the other side it acknowledged that each overhead line represents technological choices and social impacts. Overhead lines, from our high-voltage transmission towers to the nineteenth-century telegraphs, are socially constructed artifacts. To the layperson they look similar, but they can serve distinct cultural

functions and accrue separate meanings. For almost two hundred years landscapes lined with overhead wires have acted as fulcrums for the forces of art, culture, technology, and environment.

Sections of the narrative that follow read (and jump) between the lines, so to speak, but my broader agenda is to pick apart and reconstruct how electric lines transmit physical and figurative powers. The interdisciplinary approach is more fully addressed in chapter 1, but my title gestures toward this juncture of the material lines and perceptions of their impact on the landscape. In the common form *power* is an adjective that describes "lines." The lines transmit electric power between points. Although journalists and newspapers sometimes unite the two words as *powerlines*, the intentionally hyphenated compound *power-lined* sets *lined* as the participle and adjective. The *lined* in my title acknowledges the process of lining landscapes and the viewers' experiences of lined space. To focus on ways that places are lined by power is to acknowledge some of the multifarious electric powers, aesthetic powers, and rhetorical powers of electrification. *Power-lined* draws attention to the tensions on either end of the line as well as to the lines' impacts on the visible landscape.

Three general observations ground my study of power-lined landscapes:

1. Overhead telegraph, telephone, and electric power lines form circuits that transmit electricity across significant distances. These circuits have drastically different histories and uses, but by definition each type of electric "line" includes the wires or cables as well as the conductors, support beams, crossarms, insulators, transistors, joints, transformers, poles, guy wires, lightning arresters, towers, bases, platforms, and other tools, materials, and gadgets required to transmit and distribute electric currents. Since the 1840s electricians, engineers, and linemen have built, deciphered, and modified increasingly powerful, broad, and technologically advanced telegraph, telephone, and electric power lines.
2. For the sake of cost and efficiency, the majority of long-distance lines have been strung on upright structures such as poles, pylons, or towers.

3. Viewers will likely recognize the signature catenary shape, the "sag" that allows the cables or wires to shift slightly, but for the majority of Americans overhead lines seem like mere industrial stuff. The lines make ubiquitous, banal impacts on the visual landscape. If the lights stay on, if the network functions, then the material "nets" may be readily dismissed.

These are basic claims. Beginning with the telegraph, modern communication seems to require overhead wires to serve increasingly broader, higher-voltage networks. The electrification of streetlights, homes, and businesses also seems to require overhead wires. Even our modern wireless devices must be recharged—wireless requires wires. In the coming decades new superconductive materials and devices that report and predict electricity flows in real-time should lead to a more resilient and sustainable grid—the future smart grid will probably require overhead wires. Wireless transmission of power is not yet a reality. Wires seem like they are here to stay. Without a clear alternative, human civilization will most likely continue to live alongside, and be dependent upon, overhead wires.

Wires have been strung overhead across the landscape due to technological and financial constraints. Telephone lines or transmission lines buried underground may not be as susceptible to damage from storms, overgrown trees, or vehicular accidents, but when they do fail, it can be more difficult to access the buried lines to make repairs. In addition, undergrounding adds to the significant investment each line requires. In the United States planning, approving, and building a transmission line takes an average of ten years. (Transmission lines operate at higher voltages and usually span longer distances than the distribution lines one sees entering homes and businesses.) Building a 500-kilovolt transmission line costs, on average, $1.9 million per mile.[7] The estimates for running transmission lines underground is regularly six to ten times as much the overhead alternative. In urban areas and places with rocky terrain, an underground line can cost twenty times more than an overhead one.[8] Since the age of the telegraph, when private industry began to build the nation's electric networks, incurring the extra cost of putting lines under-

ground has been seen an unnecessary expense to be added to an already capital-intensive investment.

Many Americans have accepted the overhead lines as a necessary evil. They have learned to ignore or conceal electrically lined environments, pushing wires behind appliances, beneath desks, and behind walls. Hiding our wires reflects a general impulse to forget about electric infrastructure altogether. One reason we ignore the wires that power our lives is the complexity of the physical and social networks that govern the grid. The laws of physics and millions of technologies control the flow of electric currents we use every day. Meanwhile, convoluted organizations such as utility holding companies and regional transmission authorities plan, generate, finance, and regulate the massive currents coursing through these lines. Another reason why we tend to overlook the lines that weave their way across the landscape to the buttons and switches at our fingertips is that electrical engineers, system designers, and landscape architects attempt to limit the lines' environmental exposure and visual salience. They strive to create closed systems, networks that are functional, profitable, and predictable. They also, when possible, attempt to appease collective worries that the wave of visible wires flowing through our streets, parks, and backyards may never ebb. The implicit message sent by overhead lines is "Do not touch and, preferably, do not look." When the lines outside do poke into our attention, we would prefer them buried out of sight and out of mind.

The seemingly universal distaste for overhead lines' aesthetic impact is not a recent development. If transmission, distribution, and telephone lines are grouped with their archetypal predecessors—telegraph lines—then coordinated public resistance to overhead wire blight began as early as the 1870s. When telegraph wires blanketed the streets of New York City, vocal citizens demanded the cityscape be exorcized of so-called wire evil. Almost one hundred and fifty years later, complex electrical systems are still modified to appease collective aesthetic tastes. The U.S. Energy Information Administration reported in 2012 that "nearly all new residential and commercial developments have underground utility infrastructure, often required by law for aesthetic reasons."[9] Laws are passed so we will not have to look at the ugly artifacts that our lifestyle requires. These three

observations—large-scale electric networks require lines; lines have often been strung overhead; and since the nineteenth century, many Americans have preferred them to be less visible—become barbed facts when one recognizes that negative perceptions of overhead electric infrastructure are ornery obstacles to large-scale energy reform.

The United States is in desperate need of new and better transmission lines. Transmission lines carry higher voltages, often above 161,000 volts, between generators and substations. Eventually, the higher voltage, which might be considered like the pressure in a water pipe, is stepped down to serve distribution lines and then stepped down again until the electricity arrives at light systems and wall sockets. Most homes are outfitted for pressures of 120 or 240 volts, or about 1 percent of the voltage in a typical transmission line. New transmission lines are crucial to maintaining and improving the nation's aging, inefficient, and vulnerable transmission grid. One valuable intervention to our sweeping infrastructure problems might be called "grid literacy." Several recent titles, especially Gretchen Bakke's *The Grid: The Fraying Wires between America and Our Energy Future* (2016) and Julie Cohn's *The Grid: Biography of an American Technology* (2017), enhance grid literacy and explain the complex relationships between technologies and stakeholders (including engineers, politicians, investors, executives, regulators, environmentalists, and consumers) that helped to electrify the nation. Bakke's narrative focuses on the disruptions between utilities and energy users. Cohn's recounts the history of interconnection efforts and the repeated calls for a national grid that might ship power coast to coast. Both authors recognize the power lines that intersect the landscape, but they also imply that, despite increasing grid literacy, Americans' opposition to overhead power lines continues to impede progress.

Public resistance to power lines can lead to construction delays, numbing litigation, frustrated engineers, and angry citizens. Resistance is not homogeneous; concerns about health impacts, drops in property values, or dangers to habitat and wildlife also fuel concerns.[10] Chapters 4 and 5 address varied impacts and forms of resistance; however, the most widespread, difficult to pinpoint, and seemingly intractable point of opposition to overhead lines is their visual or aesthetic impact. Bruce Wollenberg,

a professor of electrical and computer engineering at the University of Minnesota, explains the opposition in blunt terms: "People don't want power lines—period. They don't like the way they look, they don't like a lot of things. It's universal across the country, and I think across the world. People don't want power lines. They don't want more power lines."[11] People want, and need, safe, reliable, inexpensive communication and power, but people do not want to *see* the lines that this privilege requires.

Of course, blanket claims such as "people don't want power lines" or arguments that suggest that the resistance is merely a matter of aesthetic preference can shift too much responsibility onto the viewer. Such claims can lead one to dismiss resistance as ignorance (e.g., "If they understood electricity and business, they would not complain") or all opponents as NIMBY, standing for "Not in My Back Yard." NIMBYism implies that naysayers expect the benefits of a shared resource but will not tolerate any infringement on their personal lives or property. The technical specifications of each line, each landscape, and each public engagement effort are distinct. We might all benefit by increasing our technical and cultural understanding of the technologies and infrastructures that pass through our yards, enter our homes and businesses, and upon which we rely for food, water, energy, transportation, and information. Scrutinizing the immediate systems through which we produce and consume energy can highlight our capacity to create large-scale, positive change.

GAME OVER. My research of power-lined landscapes began as a way to help viewers and communities find new ways to appreciate the lines in their landscape and, potentially, accept the new lines necessary for grid reform. A turning point occurred when I "lost" the power lines game. On June 11, 2012, I stood in Coral Ridge Park, a well-manicured green space in the suburban city of Chino Hills, approximately thirty-five miles east of Los Angeles. Like Henry David Thoreau had done in the 1850s, I touched, peered up, and pondered the existence of a new structure meant to hold electric lines. In *Walden* Thoreau famously criticized telegraphic communication and other "modern improvements" as "improved means to unimproved ends." He also listened, quite literally, to telegraph lines. The strange sounds of this "telegraph harp," he notes in his journal, "always

intoxicates me, makes me sane, reverses my view of things. I am pledged to it."[12] That day in Chino Hills I touched the base of a 198-foot tubular steel pole that had been bolted into place but not yet strung by wires. Instead of an eerie whine or high-voltage corona discharge, a hot San Bernardino breeze swept across the sun-drenched valley. I craned my neck and beheld the whole—the pole rose twenty stories, and near the peak, three sets of curved arms stretched to a 60-foot wingspan. Each arm had a stringing block, a wheel waiting to pull cables across the sky. An uninterrupted row of similar steel configurations lined up in the distance and split the patchwork of two-story homes and winding cul-de-sacs (fig. 2). The towers' visual impact reflected a community split over if and how they might fight the line and its owner, Southern California Edison.

The 198-foot towers were part of Southern California Edison's Tehachapi Renewable Transmission Project. The Tehachapi Project would provide a remarkable link in the region's cutting-edge energy infrastructure. At the time it was the nation's largest transmission project devoted primarily to renewable energy. At capacity the 173 miles of new and upgraded transmission lines could transmit 4,500 megawatts, enough wind and solar energy to power approximately three million homes and help to achieve California's ambitious goal of using 33 percent renewable energy by 2020. The environmental benefits of this $2.4 billion power line project seemed unprecedented; however, a 3.5-mile segment of the Tehachapi Project passed through a narrow suburban right-of-way in Chino Hills.

Despite strong opposition from the residents and businesses of Chino Hills, the route and design for the segment through the city was approved in 2009. Construction began the next year. However, in late 2011, after the massive towers had been erected but before conductive cables could be strung and electrified, a court order from the California Public Utilities Commission (CPUC) paused construction. The final tower height of 198 feet meant the line required a separate review by Federal Aviation Administration (FAA). This review would determine where to place orange marker balls and flashing red lights to alert airplanes to the presence of the new, taller lines. The FAA review provided opponents of the Chino Hills segment with a game-changing delay.

2. Steel towers for 500kV transmission line in Chino Hills, California, 2014. The 198-foot towers formed a segment of the Tehachapi Renewable Transmission Project. A court order later forced Southern California Edison to remove the towers and run this section of the 500kV line underground. Photo by Thomas Cordova.

When I first visited Chino Hills, the line was nearly ready to be energized; based on what I had read about it in newspapers before my trip, I thought the line should proceed as planned. It was not perfect, but the environmental mandate must have precedence. Then, as my eyes scanned from tower to tower, I realized that none of the mental acrobatics and alternative views of power lines I had performed in my past had prepared me to accept these intimidating structures. As I spoke with residents and learned more about the circuitous means that utilities can take to achieve quasi-environmental ends, I felt as if the figurative player in my power lines game had jumped . . . and fallen flat on his face. This line may have been built with cutting-edge technologies and the overall intention of reducing carbon emissions, but the planning process did not account for the line's severe impact on the landscape. When one imagined the planned pack of electrified cables beaded with orange marker balls and studded with flash-

ing lights, it seemed clear that this space would be horrifically disfigured by the power line.

The overhead segment in Chino Hills never fully materialized. In July 2013, after a long court battle and a vigorous grassroots campaign, the CPUC reversed its original decision. Five lattice steel towers and eleven tubular steel towers within the residential area of Chino Hills were removed. The conflict in Chino Hills is more fully described in chapter 5, but the feelings generated by those towers made me more sensitive to the massive and often opaque powers that continue to embed and control the energy infrastructure in our environment.

RESTART. I continue to observe, question, protest, write, and play power lines. I promote grid literacy, but I also recognize that other teachers and experts are better equipped to advance scientific and technological understanding of electricity and electrical systems. We need to learn more about the herculean efforts of engineers, line workers, environmentalists, politicians, and policy researchers who maintain current lines and who have devoted their lives to building new, better energy infrastructure. Yet I also believe that using the humanities to contextualize electric infrastructure's wide-ranging impacts can help to garner public support (or at least tolerance) for more egalitarian and ethically responsible infrastructure. Protecting our planet and maintaining our quality of life will likely require new, more powerful, and more advanced overhead power lines. More, and different, lines should appear upon the American landscape. However, I am not a power lines apologist. Some lines have been, and will be, ill conceived, misplaced, and rightfully resisted. Here I attempt not to take sides in favor of exploring the traditions, values, and functions that overhead lines enhance and disrupt as they intersect the American landscape.

A project that began with a boy following a series of metallic menisci outside a station wagon window has swept across the archive and the continent. I have inspected pioneer power lines near Niagara Falls, felt the sublimity of lattice steel towers cliff-hanging over Hoover Dam, heard crackling kilovolts gliding over Minnesota farms, and been appalled by 198-foot "monsters" in Southern California. Now the circuit has closed. After

a decade in New York City and four years in Santa Barbara, I moved back to Omaha with my wife and our two daughters to finish this manuscript.

Nebraska is a fitting place to figuratively "beat" my power lines game. In the mid-1840s, when the electric telegraph was new, few Americans understood how it could carry messages so quickly. Many thought the insulated wires were like thin tubes and that the messages could be rolled up and blown to their destinations. An anecdote repeated in national magazines recalled a foolish farmer near Lincoln, Nebraska, who "walked three miles" and stared at the telegraph lines, waiting to "see the man run along the wires with the letter bags."[13] The "man" that this anonymous (and possibly fictitious) farmer expected to see running across the telegraph line seems similar to the imaginary guy with whom I played power lines. Although different lines of thinking inspired our respective imaginations, I'd like to think that viewing overhead electric lines as tightropes or as an undulating running path is part of my Great Plains DNA.

When we moved back to Nebraska, my family and I lived with my father in the split-level house wedged between Blondo Street and Interstate 680 where I was born and raised. The distribution line that brings power to the house links to a transmission line that stems from the Omaha Public Power District Blondo Street substation less than a mile away. That substation, and the broader impact of public perceptions, inspires chapter 6, the last level in my allegorical game.

This afternoon the substation's constant electric drone is being canceled out by the crashing waves of interstate traffic. A 140-foot-tall lattice steel tower is visible across the interstate. Adding for elevation (approximately 1,200 feet), it is one of the tallest structures in the broad, flat plain that stretches toward greater Omaha. I stand on the front porch and look across the stream of flickering cars and semis to the transmission tower, which stands in a thawing cornfield. Like Don Quixote gazing at a windmill on the horizon, I squint at the cellular antennae on the tower's shoulders and imagine they are a knight's armor. The giant's torso twists away from my line of sight, one arm stretches southward, the other to the northwest, both outstretched arms buzzing with tension, challenging me to finish the game.

First, press PLAY.

POWER-LINED