

The Invisible Sinking Surface

Hydrogeology, Fieldwork, and Photography in California

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HYDROGEOLOGY AND A PICTURE OF A SINKING STATE

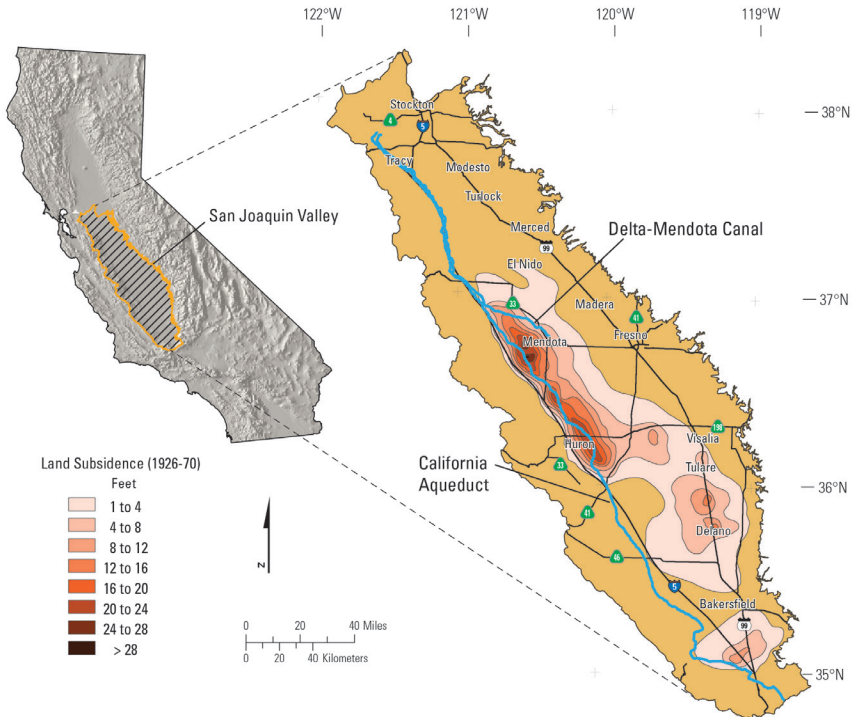
In 1977, United States Geological Survey (USGS) hydrogeologist Joseph Poland staged a symbolic photograph (figure 7.1). Standing by a power pole in a typical California Central Valley agricultural landscape surrounded by vineyards, Poland posed without fanfare, in shirt sleeves, khaki pants, and a hat, one arm up against the pole, the other down by his side. Tacked on the pole at varying heights, from the ground at his feet to high above his head, four large placards printed in bold black letters delivered a cryptic environmental message. The highest placard, thirty feet off the ground, displayed the year 1925; halfway down the pole, another announced the year 1955; and, leaning against the pole on the ground near Poland's feet, a third identified the current year of the photograph, 1977. A fourth sign, attached at about head height next to Poland's uplifted arm, listed five facts in block text:

SAN JOAQUIN VALLEY
CALIFORNIA
BM S661
SUBSIDENCE 9M
1925-1977

With this, Poland delivered his strident visual message: in the San Joaquin Valley of California where he stood, at the topographical benchmark numbered S661 near the town of Mendota, the earth's surface had subsided nine meters, nearly thirty feet, between 1925 and 1977. Translated, Poland and his USGS team that devised the photograph conveyed its urgent report: that in the course of fifty years the land's surface where Poland planted his feet had sunk an average of a half a foot a year, and was still sinking (map 7.1).¹ A newspaper article from the period put it



FIGURE 7.1. Hydrogeologist Joseph Poland, USGS, standing at the point of most extreme land subsidence near Mendota in the San Joaquin Valley of California, 1977, by Dick Ireland. James L. Borchers, *Land Subsidence 1998* (USGS 2019), 1, 65. Photograph is in the public domain. File provided courtesy USGS Water Science Center, access provided by Sally House, Science Communications: www.science-base.gov/catalog/item/58335611e4b046f05f21f69f.



MAP 7.1. USGS Map showing land subsidence in the Central Valley of California between 1926 and 1970. Note the point near Mendota, Poland's Benchmark Number S661, the point of most extreme subsidence. Online in meters at <http://water.usgs.gov/ogw/pubs/fs00165/> (Land Subsidence in the United States, USGS Fact Sheet-165-00). Public domain map provided courtesy USGS California Water Science Center, prepared by Michelle Sneed, Hydrologist.

this way: "Joe Poland stands beside a utility pole that dramatically demonstrates how far land . . . has sunk in 52 years. Without subsidence, the grapes to the right would be growing at the 1925 land level" (Barnes n.d.). Poland's unassuming pose invited viewers to stand in his place, crane their necks upward more than thirty feet along the power pole, and imagine their own two feet standing upon a now-vanished land surface that had hovered high above their heads in the empty air. At the same time, the image unveiled the invisibly subsiding water stores beneath Poland's feet, exposing the patent fact that his soles were not planted upon *terra firma*, but upon a steadily subsiding land surface. Poland's visual message sounded an alarm, that the time had long passed to remedy California's crisis of disappearing groundwater.

With the 1977 photograph, Poland and his USGS groundwater team had devised a simple visual means of conveying a complex hydrogeological concept: *land subsidence* is the sinking—or subsiding—of an extent of the land surface, resulting from groundwater pumping through wells. As water is pumped to the surface, the subterranean spaces compact and compress, and the land surface sinks with them.

With excessive pumping from large-scale wells, compaction of porous clay-rich soil layers (aquitards) reduces the spatial volume of aquifers (underground water stores are held in aquifers and aquitards) as internal water pressure reduces. Without the internal water pressure, the soil and rock that make up the aquifer structure cannot bear up under the structure's own weight: the aquitard spaces collapse, and the land surface capping them subsides with it. In other words, the "surface expression" of subsurface collapse and compaction is land subsidence (Prokopovich 1973, 191). USGS California Water Science Center hydrologist and land subsidence specialist Michelle Sneed explains the hydrogeology this way: "All sediments are porous to some degree, but aquitards 'retard flow' because water doesn't flow very well through clay-rich material. Put water on top of playdough and see how long it takes to flow through (it'll evaporate long before it flows through)."²

Try another analogy: fill up a box with full water balloons. Balance a substantial flat object—let's say a geology textbook—on top of the balloons so that the book is supported by the water pressure held by the balloons. The balloon surfaces and water under pressure within them represent the subterranean aquitards and aquifers holding the water in. The geology textbook is the land surface. Now, release a little water from each water balloon, one by one, so that the pressure the water exerts on its surface diminishes. Without the water's pressure keeping it filled, the balloon's material surface compacts, and the spaces that once held water close in on themselves. The balloons collapse and flatten, and the geology textbook begins to sink, at a rate of subsidence equivalent to the water pressure's release. With the withdrawal of water from the aquifer, the aquitards compact, and the land surface—the textbook—ends up at the bottom of the box, or, in the visual language of this chapter, beneath Joseph Poland's feet.

At the time of Poland's photograph, the extent of sinking land surface in the Central Valley amounted to more than forty-three hundred square miles affected, with one to thirty feet of vertical land subsidence taking place between 1926 and 1970 (Poland et al. 1975, 11) (map 7.1). And, it is still subsiding.³ Today, the USGS webpage displays Poland's photograph with an annotated caption that summarizes the land subsidence science behind the balloon and playdough analogies:

The compaction of unconsolidated aquifer systems that can accompany excessive ground-water pumping is by far the single largest cause of subsidence. The overdraft of such aquifer systems has resulted in permanent subsidence and related ground failures. In aquifer systems that include semiconsolidated silt and clay layers (aquitards) of sufficient aggregate thickness, long-term groundwater-level declines can result in a vast one-time release of "water of compaction" from compacting aquitards, which manifests itself as land subsidence. Accompanying this release of water is a largely nonrecoverable reduction in the pore volume of the compacted aquitards, and thus a reduction in the total storage capacity of the aquifer system. (USGS 2018)

Poland's role as photographic courier had been percolating for years. His first geology field research in the 1930s as a graduate student at Stanford University identified

the new scientific reality of land subsidence as measurable and caused by subsurface water drawdown across entire valley regions. Continuous research through subsequent decades proved that subterranean soil compaction and a sinking land surface followed from a persistent practice of industrial pumping of groundwater for irrigation; his projects had also concluded that withdrawal of petroleum caused not only land subsidence but also sea water intrusion into fresh water aquifers near the coast. In 1954, Poland joined the USGS in Sacramento to lead the first major study of land subsidence in the United States. There, he changed the scope of his profession in two ways: first, by combining the formerly separate fields of land and water study to create the discipline of hydrogeology, and second, by initiating on-the-ground research in the field as part of scientific study. Rethinking the traditional practices of modeling derived by mathematics computation and of in-lab study, Poland “perceived that areas of land subsidence provided natural field laboratories” (Riley 1998, 19). He reasoned that, working outdoors in the field, hydrogeologists could gain “more comprehensive understanding” of “difficult-to-measure but vitally important in-situ properties” of interactions among land, water, and grand-scale industrial pumping than they would derive from in-lab and mathematical study only (Riley 1998, 19–20). In the 1970s, Poland began taking colleagues on field trips to the point of most extreme subsidence near Mendota, California, where he and several of his USGS hydrogeology colleagues conceived and staged the 1977 photograph (Borchers 1998, 64; USGS 2018; 2019).

The photograph achieved two aims, one informational and another experiential. First, the image made land subsidence clear in physical terms, and second, it delivered a shock experience of discovery, realization, and urgency (Shiff 1992). With this, the photograph succeeded—and still succeeds—in making viewers feel complicit in the act of inflicting irreversible damage upon the earth, at least in those viewers disposed, like Poland, toward empathy regarding environmental consequences of natural resource overextraction. Within the groundwater world, the man by the pole is recognized as Joseph Poland and makes an indexical reference to the scientific work of the USGS. Outside that world, for viewers who do not realize the message is related to the identity of the messenger, the anonymous figural image (man, ground, pole, placards) signifies to any audience—from water experts to policy makers and the general public—the physical effect of groundwater pumping, the sheer scale of a vanished earth’s surface, and the importance of invisible underground bodies of water permanently lost. The body of scientific, hydrogeological knowledge informing Poland’s deceptively simple photograph exposes the invisible consequences of water resource extraction and its environmental effects, and as it does so, it sharpens an impulse in viewers to question that situation, to interrogate the powerful forces in industry, technology, and capital that leveraged resources to create a modern California. An entire future, now past, has funneled water, land, and people as if these were currencies due on a promissory note banking on what water can grow. The photographs ask society to address

a nagging cultural uncertainty about the state of the environment, as a way to articulate the question now emerging, of how to live *with* water into a next, more stable, future.

The invisibility this chapter addresses takes two forms: one of land and the water within it, another of the laborers who work with that land and that water. At the outset and on the surface, the chapter analyzes land subsidence: the measurable but invisible sinking of the earth's surface with subterranean soil compaction due to agricultural groundwater overdraft over time. This is physical subsidence. The chapter also interrogates a hidden subsidence of a social kind: the socioeconomic and racial leveling of agricultural farmworkers who operate beneath a figurative cultural surface. Both types of subsidence—physical and social—are historically connected to the extremes exacted by industrial agriculture's water uses. This chapter examines ways in which mindful photography created a field of visual problem-solving regarding water, land, people, and ideas that labor on and with it. An interesting distinction appears in the images I analyze later in this chapter: in the photographs of the scientist, the photographer, and the organizer, their *professional* bodies are presented as discrete from time and removed from the land they study and capture, and upon which they gather. Contrast this with the photographs of farmworkers, whose *bodily labor* and the land they work are intertwined and inseparable. Juxtaposing and paralleling photographic representations of worker, land, and water, with an eye toward how they are enmeshed in their difference, can reveal changing ideas about how water *works* and how it *is worked*, on and under the surface.

VISUALIZING SUBSIDENCE: MODEL AND PHOTOGRAPH

Joseph Poland's photographic representation of land subsidence succeeded in staging the conundrum of placing the invisible on view. Poland's image did this in the way it presented the forms in the picture, in effect both reinforcing and defying standards for typical landscape photography, typical portrait photography, and typical agricultural photography of the era. He also built upon a practice by scientists of his time, to present scientific data in visual form, usually by way of physical, built models.

The landscape in which Poland stands is recognizable as a California agricultural landscape, with vineyards extending to the horizon on a flat extent of land. The vineyards are bounded, divided, and traversed by a road and lines of power poles. These appear vertical in the photograph, in lines that reach to or parallel the horizon, though the horizon's vanishing point is blocked by a farm complex of buildings in the background above Poland's head. The hydrogeologist stands in the landscape ostensibly as a measure of comparative scale, in ways that depart from the expected role of the human subject in traditional landscape painting and

photography and in the expectation set up in documentary agricultural photography (Borchers 1998, 64–65).

The extreme vertical orientation the pole creates, joined with the proximity of the vertical elements to the “front” of the picture plane, requires the “foreground” to extend upward to the top of the picture plane. This permits a direct focus on the “1925” year sign, where the electrical power lines converge. The power lines anchor *both* the flatness that the pole’s verticality imposes in the foreground *and* the illusion of receding poles moving toward the blocked horizon. These effects are amplified by the aerial perspective: the camera is positioned above the scene, looking down upon it. All of this remains undetected by the illusion of simplicity in the photograph: a man stands next to a pole in a vineyard. In this way, the picture succeeds in linking the vertical to the horizontal, allowing the vertical plane to represent an enigmatic “depth” that inverts the traditional idea of landscape depth, usually defined by the recession that perspective creates, toward a vanishing point on the horizon. I say “inverts” because now, instead of the landscape picture indicating depth as the quality of optical recession in a picture of a landscape, it reconfigures depth vertically, with the pole as a sign for volumetric depth: of water under the earth. In other words, the pole can also be read as a well shaft, both exposed by past subsidence and descending underground into the invisible terrain yet to be unearthed by the sinking ground surface upon which Poland stands.

Poland had been working for years on ways to represent the invisible depths of land subsidence in visual form. Grounded in his early work in the Santa Clara Valley in the 1920s and ’30s, where he and his research team confirmed and named the phenomenon of land subsidence, Poland became a pioneer in creating visual representations, models, and photographs that would allow scientists, and the general and governing public, to understand it. As early as 1932, Poland was sharing with colleagues his finding that the field of groundwater geology was “of vital importance in the future development of California. When one realizes that at present, the annual drop in subsurface water level averages from four to six feet in most of the California valleys, the necessity for artificial replenishment in the near future is readily evident” (Poland 1932).⁴ This was a “visionary” concept in 1932, according to Sneed, but is a growing necessity today.⁵ Poland included a historical caveat, that little work could be done in his time on the issue of groundwater, either by private individuals or by public agencies, due to “the state of business” wrought by the Great Depression, adding that “primarily for that reason, we have barely been keeping the wolf from the door”⁶ (Poland 1932).

Hydrogeology reports on groundwater and subsidence came to rely on two-dimensional graphs, drawings, tables, charts, and maps, all standards in scientific publication (e.g., Curtis, Reid, and Ballard 2012; Latour 2014; Pang 1997; Perini 2006; Roberts 2017; Rudwick 1976). For public and nonspecialist display, Poland devised three-dimensional models for newspaper articles and presentations when he reported on land subsidence. This followed a period standard: a scientist or

engineer stood in a photograph next to a physical three-dimensional model, with a caption describing the model and the concept the model represented. The model-author expert substantiated the science. Poland's USGS graphic models and his clear claims, backed by visible scientific evidence, contributed to newspaper reporting on land subsidence findings. In Southern California, articles and photographs on the topic ran in several newspapers (Gesner 1941; "Heavy Water Pumping . . ." 1946; "All Water Wells Pegged" 1947; "Water Conservation Urged . . ." c. 1940s–1950s). In the 1940s, newspapers related environmental consequences of groundwater depletion and salt water intrusion resulting from overpumping of water or petroleum near coastlines. In conjunction with reports on a USGS survey of land subsidence and salt water infiltration along California's coast, photographs appeared of the subsidence model Poland and the USGS had devised, representing land surface levels sinking to below-sea-level elevations. The model took the form of a tabletop punctured with vertical pegs of different lengths, each representing a well. The tabletop to which the pegs were attached indicated groundwater levels, and a string tied horizontally above the tabletop model represented sea level. The aim of the model was to demonstrate that the ground level had sunk below sea level. One of the first photographs of the peg model appeared in 1941, with Poland and geologist A.M. Piper standing next to it. The Los Angeles *Daily News* article, on sea water infiltration into freshwater aquifers due to groundwater overdraft, included the following description of the peg model:

The USGS has developed an interesting method of charting drilling logs of the thousands of wells involved. A three-foot shaft—resembling the shaft of an arrow—is marked in various colors along its length. The colors represent the differing formations encountered in drilling. Thousands of these shafts, each representing a well, are stabbed into a large map at the site of the well, giving an upward projection of the various formations underneath. This enables the engineers to make a three-dimensional study of the underlying formations. (Gesner 1941)

The power pole in Poland's picture, then, might represent an exposed well casing, as if from the peg model writ large directly upon terra firma. Sneed reports that this literal perception is not uncommon: she has often been asked at scientific meetings whether the utility pole in Poland's photo might actually be a well casing made visible by subsidence.⁷ In Poland's picture, the topmost, "1925" placard signified the now-invisible past land surface *and* the volume of its prior subsurface depth, from aquifers and aquitards long since emptied, compacted, and vanished. Where the peg model would also show the subterranean well peg below the surface, Poland's viewers were left to the power of suggestion, "seeing" by association the sub-depths beneath the subject's feet, now (before and since 1977, and, without remediation, forever) in the process of disappearing. The picture enacts an ongoing future of subsidence.

The photograph imparts information, but its legacy is that it also ignites a shock experience (Shiff 1992). The *experience* of the photograph is to imagine standing

on the ground's past surface, "up there" in the empty space above the pictured man's head: above our heads. This brings a sense of the *inversion* of the electrical pole: it both rises from and punctures down into the ground where it stands. The pole is as much a utility pole rising up from the ground in 1977 as it is a likeness of a well shaft bored into an aquifer in 1925. When this well shaft analogy stretches the reach of the image, allowing the pole to signify the invisible past store of water whose disappearance has taken place in an unseen subterranean, then the pole-as-shaft marks the site of a puncture, a wound both hidden and exposed. The experience brings this insight, that human industry physically wounds the earth, and confirms an ethical weight to the problem, as viewers see that, being part of the industrial culture that extracts water without limits, we are complicit in the breach and the wound. The ultimate power of this image is its requirement that we—its viewers—engage the grave realization—the shock—that we are accessory to and yet beneficiary of this continual, lasting and irreparable harm. Moving further, attuned viewers see that this is not a "past" situation, but a recurring, and current, problem: in 2021, we are nearly fifty years past 1977, and approaching the century mark from the 1925 ground level. Subsidence continues. The experience of Poland's immersion in a field of absent water brings new knowledge, that the effects of subsidence are wounds—punctures, fissures, tears, cracks, depressions, sinkholes—in the earth's surface as an entire region physically sinks and keeps sinking. When the photograph "makes sense"—when the viewing becomes a sense experience of a physical harm that results in the earth's very movement—it brings associative moral pain, guilt by cultural association, shame of the unwitting accomplice (Benjamin [1931] 1977; Benjamin [1936] 1968). Apprehended fully, the photograph activates a sense of collective responsibility for the pain of a wounded planet: these are wounds we helped to cause, against earth, against water, against ourselves.

PHOTOGRAPHIC FIELDWORK AND PHOTOGRAPHS OF FIELD WORKERS

Between the 1920s and the 1980s, out of the growing interest in the social inequities that accompanied water systems development in California grew the field of social documentary photography. From images of transient Dust Bowl and Great Depression workers, to photographs of Mexican braceros, interned Japanese farmers, Black and Filipino migrant laborers, and United Farm Workers, photographers exposed a previously invisible social landscape and the faces of the laboring classes who bolstered massive-scale water extraction schemes (e.g., Finnegan 2003; Gordon and Okihiro 2006; Lange and Taylor 1939; D. Mitchell 2012; Street 2004; 2008). The rise of California's network of water conveyance systems during this time, both across and beneath the ground's surface, participated in an industrial-scale agricultural empire meant to feed and water California's insatiable twentieth-century regional metropolis far into the future. Poland's career in

California groundwater study, which began in the 1930s during the Great Depression, was concurrent with the historical timeline of California's large-scale industrial agricultural business. By association, that career also grew up alongside the social history of labor groups that the agriculture industry relied on to make that business productive and profitable, and it bore witness to the social justice movements that worked toward equity for those workers. Paralleling this history came the social documentary photography profession that recorded it all in pictures.

In the foreword to Richard Steven Street's book *Photographing Farmworkers in California* (2004), California historian and former state librarian Kevin Starr (2004) observed about California's agricultural lands that "the pastoral contentment of the early photographs—their emphasis on field, sky, crop, and willing workers—now yields to photographs documenting the remorselessness of piecework in the fields, the inadequacy of housing, the early efforts at organization, and the browning of the workforce" (Starr 2004, xiii). This identifiable conflict between art and documentation in agricultural photography arose in the 1930s, when photographers began to shift from pastoral views of field labor, inherited from more traditional landscape traditions, to social commentary focusing on race and class injustice (Goodwin 1998; Starr 2004). This shift, with photography emerging as witness and social critique—even as protest—suggested a struggle within "the interaction of documentation and aesthetics, especially when art is offering, or so it seems, a shortcut to a more fundamental truth" (Starr 2004, xiii). Indeed, the scientific and social documentary photographs I discuss in this chapter attend to Starr's "more fundamental truth" about historical relationships among water, land, and people in California (2004, xiii). Here, the material value of water rose as it was abstracted into economic and social capital, lost its physical properties, and became a commodity prone to be considered waste; the social status of the laboring bodies that sustained this system subsided in status as work and worker became commodified (Cotter 2016; D. Mitchell 1996). This seeming conundrum harks back to the pioneering transparency of social economist Thorstein Veblen (1899), who made plain that *status*—claims of social superiority based on the appearance of material wealth—creates high social stability in a privileged class and requires the judgment that people outside the self-proclaimed class of privilege are lower in value. The tendency to obscure, then, in the context of Central Valley water history, not only hides geological problems; it also curtains consequences of the problem-that-must-not-be-named to the environment and affected social groups. Over time, nested cultural practices worked to keep water problems, and their social and ecological effects, invisible. The "more fundamental truth" that underlies the photographs, then—which Starr leaves unnamed—is a truth of unjust and uncorrected practices that drive toward social imbalance, when water is a capital companion to land and agricultural development (Starr 2004, xiii).

Writing about Depression-era photographs of Black American laborers, James Goodwin insists that "mere depiction or description of appearances does nothing

to lift the veil” from the deep cultural norms governing social thought and practices about status in relation to skin color and social class (Goodwin 1998, 284). Analyzing Richard Wright’s text for his book of social documentary photographs, *12 Million Black Voices: A Folk History of the Negro in the United States*, Goodwin traces ideas of race in American society from W.E.B. Du Bois to Wright, finding that “one psychological effect of the color line in America . . . [was] to have drawn a veil that screens the black world from the white one. For Black Americans this veil, depending upon the social context, proves to be variously impenetrable, reflective, or, at moments, translucent. For white Americans, the veil is presumed to confirm stereotypes or phantasies about blacks or to attest their invisibility” (Goodwin 1998, 284; see also Frank 1998; Puskar 2016; Shiffman 2007; Street 2004; Starr 2004; Wright and Rosskam 1941). In looking at agricultural social documentary photographs of nonwhite field workers in California, the practice of obscuring race and class “through a calculated opaque mask” (Goodwin 1998, 284) is a patent race-class invisibility grounded in long-held cultural norms (D. Mitchell 1996). Social documentary photographers in California from the 1930s onward unveiled problems of an imposed marginalization in their pictures of bodies laboring within the land. What were the margins, and who was pushed into margins by whom, for entire social groups of field workers? In a context of geographical, social, economic, and political segregation, a lowered quality of life—low status—played out in all its racialized variations: in control by forced labor and erasure of native Indigenous peoples; in generations of Chinese laborers beginning with the Gold Rush and the Chinese Exclusion Act in the nineteenth century; in waves of Dust Bowl and Depression-era migrants in the 1920s and ’30s; in the internment of Japanese at war relocation camps during World War II; in the bracero workers cargoed from Mexico to replenish a shrinking labor force; and in the Black, Filipino, and Mexican migrant field workers who subsequently created the context for the United Farm Worker movements into the 1970s.

Poland’s own fieldwork was taking place along the duration of these movements. He had joined the Sacramento office of the USGS in the mid-1950s to lead newly established research projects on groundwater and subsidence science. During his entire tenure there, farmworkers were organizing throughout the San Joaquin Valley and California, in many of the same locations as his field laboratories. Most prominently at that time, nonunion Filipino and Mexican field workers comprised the backbone of California’s early United Farm Worker movement, led famously by César Chávez and Dolores Huerta (Gunckel 2015; Street 2008). The organized strikes, marches, and fasts, and the attendant violence, were magnetic subjects for social documentary photography. To this day, prominent social documentary photographers like Matt Black, for example, raised in the Central Valley, focus the lens of exposé on the repeat-shock of continued race-class depression and social injustice in Central Valley agricultural and rural communities. Jason Puskar has argued that photography has historically occupied two territories:

“deeply complicit with Western racism” but also able to “disrupt entrenched power relationships” (Puskar 2016, 169). Agricultural documentary photography continues to play its role in exposing issues of race, gender, and class while “shaping public perceptions of life and labor in the fields” (Street 2004, 300; 2008).

SOCIAL STATUS, RACIAL ERASURE

In 1935, Dorothea Lange, the New Deal photographer, in her most famous portrait, positioned herself on the roof of a car, balancing her camera upon her bent knee and peering through the viewfinder to a scene outside the picture frame (Taylor c. 1935). For documentary photographers, shooting from the top of a car was a common way to gain the elevated vantage point that could capture the people working in the flat extent of the Central Valley landscape. In one way, then, this photograph of Lange documents a photographer’s method, but Lange’s portraitist stands at ground level shooting upward. This point of view accentuates Lange’s separateness from the territory of the farmworker. Her body, like Poland’s, unites physically, through touch and positioning, with the tools of her documentary trade (car and camera). Lange’s photographer accomplishes this fusion formally, with the triangulated compositional form of her pose upon the car. And, looking up at her from the ground, her portraitist captures her in concert with car roof, high-power lines, and clouds, presenting Lange as existentially *elevated above* that which she photographs: she represents elevated status. As in Poland’s picture, vanishing points and horizon are blocked, yet implied. The picture reads as a figure in a landscape. Lange’s pose presents an independent, specialized, middle-class, white worker in a field whose labor, gender, and class status structure her at a distance from her subject: field laborers *within* the landscape, absent but implied, outside the frame, working *with* the land. Her role in this photograph (and in others like it from the period) is to observe and comment *upon* and *above* the land, not to participate *within* it. Like the scientist, the photographer is apart from the landscape, not a part of it.

Lange’s portraitist, her partner in work and marriage Paul Taylor, was well known as a University of California, Berkeley immigrant-labor economist. The pair embarked together on a study in the Central Valley to explore and expose social, economic, and racial inequities imposed on migrant and immigrant working poor in agricultural California. Their 1939 book, *An American Exodus: A Record of Human Erosion*, is a photo-text that exhibits “apprehension over the adequacy of photography to convey the full complexity of the social changes it examines” (Goodwin 1998, 287). Certain of Lange’s Farm Security Administration (FSA) images had cemented her identification in the public eye with the human crisis of Dust Bowl drought on the American Great Plains, but for this joint project, she and Taylor worked more in California’s agricultural terrains. There, Lange immersed herself in agricultural social structures and practices to carry out both

her FSA work and the collaborative projects with Taylor. Combined, the two projects exposed collapse within the long-held rural farming ideals that were still active in the American cultural imagination. As Linda Gordon explains:

The FSA's photography project was supposed to promote not only Department of Agriculture programs but also a New Deal vision for rural America, a difficult assignment because of the incoherence of that vision. The project reaffirmed family-farm ideology through its frequently romantic, picturesque approach to a "simple" and community-spirited rural life and its condemnation of plantation and industrial agriculture. . . . [Yet], the extraordinary popularity of some of [Lange's] photographs has decontextualized and universalized them, categorized them as art, and thereby diverted attention from their almost social-scientific significance. (Gordon 2006, 700–701)

The photographs of Dorothea Lange and Joseph Poland at work on the landscape present them as confident, modern, master professionals fused with the tools of their technological wizardry. Each is an expert observer and recorder working *upon and over* the land, not as laborer *within* it. Contrast these images with a famous photograph of Dolores Huerta, the principal organizer, with César Chávez, of the United Farm Workers movement. The photograph was taken by documentary photographer Harvey Richards, who titled it *Dolores Huerta HUELGA Sign, Without a Doubt the Iconic Photo of the Delano Grape Strike, 1965* (Richards 1965). Huerta, like Lange, stands atop a car facing toward the farmworkers with a sign marked by the United Farm Workers logo, declaring "HUELGA: STRIKE." Like Lange, Huerta stands apart from and above the field workers she faces. She is fused to the material of her work as well: the emblematic sign she holds and the car on which she stands.

All three photographs of these professionals—scientist, photographer, organizer—are backed by power utility wires, which create a formal series of lines that function visually as a background. The background serves to anchor the subject, and it also helps move and settle the eye around the picture, but in this case, the high power lines also convey a subtle message of the *power behind* the figure. Differences between Huerta's portrait and that of Lange or Poland are many. Unlike the scientist and documentary photographer, the union organizer's face and posture present an active, emotional, engaging participant: she faces the farmworkers and the field with a direct and commanding form of communication meant to actively support organization, leadership, and action. Differently from Lange's internally gathered form and Poland's poised frontal stance, the energy of Huerta's body opens outward in a bold gesture of inclusiveness toward those she invites into the act of protest and change through mass social movement.

Yet, in these portrait-like photographs of observer-professionals in the field who studied, photographed, or organized, the ever-present but elided subject is the farmworker. The observer-professionals are characterized as *apart from* or *above* the landscapes *on* which they worked; at the same time, the laboring field workers'

bodies, to which this discussion turns now, are represented as a *part of* and *within* the land they work. Mitchell attributes this disequilibrium to industrial ideologies whose tenets of operation kept farm labor pauperized, racialized, and imbued with inferiority—that is, poor, of color, and powerless (D. Mitchell 1996, 1–12).

Now, consider Dorothea Lange's 1938 photograph *Mexican Grandmother of Migrant Family Picking Tomatoes in Commercial Field*. Here, a laboring figure appears inseparable from the landscape in which she works (figure 7.2). Held down by a horizon line that seems to press down upon her back and her tightly curved body, she is multiply and inescapably anchored to the earth. Her feet, hidden behind her picking bucket, sink into the muddy furrows, steadying her as her hands disappear within the gnarled tomato vines she reaches to pick. Her black bucket and black head scarf anchor her to the field, the curved masses also working formally to keep the bent body compressed into its tight stoop. She is an expression of the stoop labor that became the symbol for and target of farmworker protests. The vanishing point, that typical hallmark of traditional Western landscape art that pulls the eye to a far horizon, is in this case pushed to the lower left corner of the picture frame, as if by the pressing of the field worker's foot against the bucket's weight. Here is a laboring body whose identifying features are mute: faceless, sexless, nameless, she strives alone with the earth and with the product of her work in "the commercial field." Lange presents a persuasive portrait of the totality of commodified labor, a documentary shot taken at the same time and in the same location where Joseph Poland's Stanford team proved land subsidence to be the result of groundwater pumping. Their research was under way in this very area, the Santa Clara Valley, when Lange captured the image in November 1938 (Tolman and Poland 1940).

Similarly to the land-bound tomato picker, documentary photographer Paul Fusco's field worker subjects toil under the weight of full picking boxes, heavy enough to make their boots sink into the tilled soil between vineyard rows (figure 7.3). *La Causa: The California Grape Strike, Farmworkers Carrying Grapes* (1968) captures the blur of action as grapes fly from the crate into the fruit collection bin. The two workers' facial expressions draw viewers into the physical labor that speeds at the pace of a by-the-box pay scale. Fusco has captured the urgent efficiency with which these pickers must do their jobs. They trudge within the vineyard rows, their hands, faces, and bodies soaked with sweat, caked with dirt, sticky with juice, and filmed with dust, pesticide, and bugs. The camera frames them as part and parcel of the soil and the plant rows themselves: they are the same height as the loaded, mature vines; their heads are even with a horizon indiscernible from the planted terrain itself. Gathered into the thick vine foliage at the front of the picture plane, vanishing points truncate where they meet the laboring bodies—handles angle toward the collection bin, slanted shadows of legs dig into the foreground, diagonal lines of the furrows hide behind their muscle weight.



FIGURE 7.2. Dorothea Lange, *Mexican Grandmother of Migrant Family Picking Tomatoes in Commercial Field. Santa Clara County, California* (November 1938). Photograph is in the public domain. Library of Congress, Prints & Photographs Division, FSA/OWI Collection, LC-USZ62-125640 or LC-USF34- 018409-E [P&P] LOT 346]. Online at <http://hdl.loc.gov/loc.pnp/cph.3c25640>.

These formal elements require the eye endlessly to cycle at the front of the picture, the forefront of action, never drawing through to the horizon. This is not a landscape, but a visual statement of the short view, on the ground, an endlessly repeated moment of immersed labor, a compression of time in specifically human



FIGURE 7.3. Paul Fusco, 1968, *La Causa: The California Grape Strike, Farmworkers Carrying Grapes*. Photograph courtesy Magnum Photos.

terms. It depicts not the agency of a professional observer of work, but the agency of a system that drives workers.

ENVISIONING INVISIBLE SUBSTRUCTURES: LANDSCAPE AND LABOR, WATER AND WORK

The reinterpretation of landscape by social documentary photographers in the 1930s focused on working bodies' relationships *within* the landscape rather than depicting landscape itself as an aesthetic object. Yet, even these photographers were vested in modern photographic practices that compelled them to make photographs noteworthy aesthetically. The federal projects of the Depression era were contemporary with the developments of socially-minded critical landscape discourses following in the footsteps of post-World War II social and Marxist economic theories, such as critical theory arising from the Frankfurt School (Jay 1996). Led by literary scholars, cultural geographers, and labor scholars, these approaches subverted traditional post-Enlightenment and Romantic concepts of landscape-as-nature and of the wilderness sublime, instead analyzing landscape images with social, economic, and political interpretations that underscored critical symbolic content. This dimension made landscape representations legible as social constructions, an idea based on a "powerful visual ideology" (D. Mitchell 1996, 2) embedded with symbolic and/or iconographic meanings that encoded the values of the societies and time frames in which they were produced

(Daniels and Cosgrove 1988). And, this approach addressed the question: who produced the construction, the idea, the ideology of landscape from the image of “a structured portion of the earth”? (D. Mitchell 1996, 2). This question bypasses the interests of individual artists, and points to patrons, collectors, and sponsors of works of art, to include government-sponsored New Deal programs, those individuals or entities with the power to commission, pay for, publish, and exhibit them. Social approaches probed and depicted political, economic, social, and cultural conditions, opening space for artists, and even scientific field-workers such as Poland, to create new ways to see landscape.

To analyze a work of landscape art—from Renaissance painting to contemporary photography—under these terms reveals that landscape traditions themselves were “integral to an ongoing ‘hidden’ discourse, underwriting the legitimacy of those who exercise power in society” (D. Mitchell 1996, 2; see also Bentmann and Müller 1992; Daniels and Cosgrove 1988; W.J.T. Mitchell 1994; Olwig 1993). As Don Mitchell points out, citing Cosgrove, Raymond Williams, and others: work makes landscapes; labor power is embodied; and “a landscape is a ‘work’—a work of art, *and* worked land. . . . It is a produced space” (D. Mitchell 1996, 7, 10, 6). In fact, he insists:

One of the purposes of landscape is to make a scene appear unworked, to make it appear fully natural. So landscape is both a work and an erasure of work. It is therefore a social relation of labor, even as it is something that is labored over. To ignore the work that makes landscape . . . is thus to ignore a lot of what landscape *is*. (D. Mitchell 1996, 6)

Going further, W.J. T. Mitchell advocates not for thinking about “what landscape ‘is’ or ‘means’ but what it *does* as a cultural practice,” of establishing and maintaining cultural power relations through images: “What we have done and are doing to our environment, what the environment in turn does to us, how we naturalize what we do to each other, and how these ‘doings’ are enacted in the media of representation of what we call ‘landscape’ ” (W.J. Mitchell 2002, 1–2).

Poland’s scientific photograph fused the hydrogeologic model with the landscape it studied, disclosing the consequences of unchecked industrial groundwater pumping for agribusiness. Social documentary photographers fused the body of the disempowered worker with the body of the worked landscape. Both exposed issues of agency and equity, and both challenged viewers to take an activist position. To compare formal and iconographical aspects of these two discrete representations—scientific and social—renders the photographs open works, candidates for thick analysis (Eco 1989; Neimanis, Åsberg, and Hedren 2015). This deepens photographic analysis as a means of defining agencies of “work” and “labor” through juxtapositions of dissimilarities between images and ontologies of the two (D. Mitchell 1996). Specifically in relationship to photography attuned to water issues and California agriculture, these critical reflections reveal a “connection between the material production of landscape and the production of

landscape representations, between work and the ‘exercise of imagination’ that makes work and products knowable” (D. Mitchell 1996, 1–2). This questioning opens fluently within the environmental humanities approach this volume advocates for the examination of water’s cultural currencies.

From the 1930s through the 1970s, Poland’s fieldwork throughout the landscapes of California’s key areas of groundwater overdraft and land subsidence would have immersed him in the period’s culture of heightened water systems development and agricultural expansion, realities accompanied by intensified farmworker struggles and union organization. After 1956, Poland “was able to devote full time to the subsidence studies,” when plans for state and aqueduct projects on the west side of the San Joaquin Valley raised subsidence concerns, “both hydrocompaction and aquifer-system compaction, because of excessive ground-water withdrawal” (Poland c. 1980, 2–3). The design and placement of the California Aqueduct of the State Water Project, built in the 1950s and 1960s, had benefited from an interagency study, begun in 1954 and headed by Poland, whose research identified “optimal siting” outside the danger zone for subsidence, and the planned aqueduct was rerouted (Borchers and Carpenter 2014, 26; Prokopovich 1973). The 1954 study was motivated in part by the aqueduct’s predecessor, the 1951 Delta-Mendota Canal of the Central Valley Project: major structural damage to the canal from land subsidence had been discovered then, and is ongoing now. The case of the redesign of the California Aqueduct based on hydrogeological science represents a major success in the application of hydrogeological findings to engineering developments. But this is in some ways an anomaly. Legal decisions regarding groundwater geology have not always been made on clear understandings of the science. Land subsidence pioneer C.F. Tolman’s comments on the politics of law and knowledge about water are revealing. In a 1940 letter to Poland, Tolman commented on a judge’s statement in a water-related court case finding: “This is an example of the difficulty of training a judge in the fundamental principles of groundwater so that he does not invent some imaginary condition.”⁸

After the California Aqueduct opened, the increased supply of surface water led to a decline and eventual halt to Central Valley groundwater pumping for several years, until demand once again outpaced supply and pumping resumed (Poland 1984; Poland and Lofgren 1984; Sneed, personal communication). Through the decades and into his retirement in the 1980s, Poland worried that aqueduct and other imported surface water supplies would not be enough to satiate California users, whether domestic, industrial, or agricultural, and that pumping would continue: “The problem is that today there have been more contracts signed for water in Southern California than there is water available. . . . If the California Aqueduct can’t deliver, pumping will begin again . . . [and] more pumping will, of course, result in more subsidence” (Becker, 1981a; 1981b).

CONCLUSION

With the 1977 land subsidence photograph, Poland and the USGS brought subsidence science and the consequences of disappearing groundwater to a wider audience, both within and beyond the scientific community. And, with his scientific method, his desire to provide wide education and leadership, and this specific photographic product, Poland was and has remained a stalwart contributor to developing public discourse on land subsidence.

Since the 1990s, groundwater scientists have replicated Poland's photographic model, appropriating his pose by the pole to offer updates on land subsidence, from Sacramento's USGS sites in the Central Valley to locations around the world, including Japan, Taiwan, and Mexico.⁹ Since its creation in 1977, the photograph has served as a visual set-point in a global focus on groundwater and land subsidence in water security science, policy, urban development, and popular environmental politics education. The photograph has become *the* standard image representing the concept of land subsidence, what many professionals and students of hydraulic systems call, in a colloquial shorthand, "that subsidence picture of the man standing next to the pole." The photograph is a graphic sound bite to any audience, from hydraulic scientists to politicians and the lay public. While the idea the image conveys is familiar—the photo has an immediate impact as transmitter of knowledge—few viewers can identify specific details: the man in the picture, the historical situation he represents, or the science behind the graphic results he displays. Even today, when I mention the photograph to water experts in any field (except groundwater study), most immediately "know" the picture, but few can identify Poland, or even realize they should.

In recent years, the urgency of the groundwater crisis has resurfaced as state groundwater management policy revives a host of historical environmental concerns—bringing Poland's photograph with it. Related crises include not only groundwater and oil pumping, but also subsurface geologic change and water contamination from subterranean mining, gas extraction, fracking, industrial runoff, hydrocompaction through extreme surface water seepage, natural peat removal or sublimation, and infrastructure collapse. Broadly visually accessible, the photo has pried open conversation onto more than the science of land subsidence; it also carries an emotional and ethical punch, a sign that signifies an unavoidable new "knowing"—that land subsidence signifies the near-permanent depletion of an essential groundwater supply we cannot do without. The photographic image opens critical questions onto a host of scientific and cultural concepts at once, questions that lead to action through exposure and discussion of the once-invisible problem. And, Poland's entry into Central Valley hydrogeology in the 1950s, grounded in his maverick experience in other parts of the state, made him a contemporary with the period of time when land and water science

developments paralleled the social justice movements that accompanied them and the social documentary practice that recorded and popularized them.

By the time of his retirement in the 1970s, Poland characterized the groundwater crisis in California's Central Valley as "probably the most severe case of subsidence in the world" (Barnes n.d.). In 1999, the subsidence in the San Joaquin Valley was considered the largest human alteration of the Earth's surface (Galloway and Riley 1999). Poland's answer to the water-overuse crisis, from as early as his initial work in the 1930s and extending throughout his career and into the 1980s, had consistently been that only "conservation of water, particularly in agricultural use," could halt the conditions that led to land subsidence. Even then, he added: "It's a political problem" (Becker, 1981b; "Water Conservation Urged . . ." c. 1940s–1950s).

This brings us to now. In 2014, California gubernatorial policy crafted the Sustainable Groundwater Management Act (SGMA), a plan for statewide water use accountability and groundwater stewardship into and beyond the middle of this century. The policy was built upon groundwater management political foundations from the 1990s that did not get fully off the ground. By 2019, water districts had met a first-stage SGMA requirement to convene and submit groundwater management plans to the state water commission, with subsequent phases of implementation requirements on the books into 2042, "the date by which groundwater basins must achieve their sustainability goal" (NGO Groundwater Collaborative n.d.). The effects of this regional policy reach deep into water futures in California, and around the world, as California's plan serves as both model and companion to global frameworks like the United Nations framework Strang discusses in this volume, and presages a future consciousness of water's multiplicities, such as Klaver suggests. Finally, such grand-scale political and cultural actions are actively engaging with the appeal for long-term effects that scientific and social documentary photographers have made through their images of the land and people of the Central Valley's surface, proactive work designed to expose, and ultimately to rectify, the pressing yet invisible water problems beneath.

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NOTES

1. The benchmark (BM) Poland reference is S661, also recorded as GU0103 at the ArcGIS website: www.arcgis.com/home/webmap/viewer.html?webmap=00ea57b3f73e43d1boae57f937bea633&extent=-120.5493,36.6637,-120.4859,36.6919, accessed July 24, 2020. Although the physical benchmark placed before 1977 was no longer found by the 1980s, the USGS now locates the spot by its GPS coordinates. The photograph with captions appears on the USGS website: www.usgs.gov/media/images/location-maximum-land-subsidence-us-levels-1925-and-1977, accessed July 24, 2020. Map 7.1 in this chapter shows the physical evidence of subsidence between 1926 and 1970, which the placards in Poland’s 1977 photograph displayed in abbreviated terms. For a map that shows older (1926–70) and newer (2008–10) subsidence, see figure 17 at <https://pubs.usgs.gov/sir/2018/5144/sir20185144.pdf> (Sneed, Brandt, and Solt 2018).
2. On the basic relationships between aquifers, aquitards, and water in the context of the Central Valley: “An aquifer system contains aquifers and aquitards. Aquifers are composed of larger grains (sands and gravels) that transmit water easily. Aquitards are composed of smaller grains (clays and silts) that do not transmit water easily. Both aquifers and aquitards have spaces between the grains that store water. When an aquifer system is pumped, water comes from both aquifers and aquitards. Some folks use the term ‘aquifer’ to include both ‘aquifers and aquitards’ as I’ve defined above. In this way, they think of the entire system as an aquifer and aquitards are part of the aquifer.” Michelle Sneed (hydrologist and land subsidence specialist, California Water Science Center, USGS), in communication with the author, July 2020.
3. See figure 17 at <https://pubs.usgs.gov/sir/2018/5144/sir20185144.pdf> (Sneed, Brandt, and Solt 2018). For a fuller context of California water at the time of Poland’s photograph, see also Kahrl (1979).
4. Poland to Dr. Kirtley F. Mather of Harvard University’s Department of Geology, August 16, 1932, in Joseph Poland Papers, Box 2, Folder 2.34, “Consulting Correspondence 1930s,” USGS California Water Science Center.
5. Sneed, in communication with the author, July 2020.
6. Poland to Mather, August 16, 1932.

7. It is a utility pole in Poland's photograph, but for some viewers it replicates a protruding well casing. In fact, "it is not uncommon for a well casing to protrude from the ground as a sign of land subsidence." Sneed, in communication with the author, July 2020.

8. C.F. Tolman to Joseph Poland, February 16, 1940, in Joseph Poland Papers, Box 2, Folder 2.22, USGS California Water Science Center.

9. Sneed, in communication with the author, July 2020.