# Inescapable Ecologies

## A History of Environment, Disease, and Knowledge

LINDA NASH

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*For Jim and Helen*

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# Introduction

One of the major cultural developments of the late twentieth century was the reenvisioning of human beings' place in the world. In many ways the most radical notion to emerge from the modern environmental movement was the idea that people were inescapably part of a larger ecosystem. The genesis of this popular understanding is typically traced to the publication of Rachel Carson's *Silent Spring* in 1962. The influence of Carson's book is undeniable. *Silent Spring* made the science of ecology accessible to a broad public and helped galvanize a generation of environmental activists who would push through several groundbreaking political and institutional reforms. But perhaps her ideas took hold so strongly and so quickly not because they were wholly new but because she had articulated existing understandings in a new way. Although Carson's book was pivotal, "ecological" understandings of human bodies have a much longer history. This book tells that story, recounting both the marginalization and the persistence of ecological ideas of health and disease as that history unfolded in California, and more particularly within the Central Valley. By doing so, it also complicates the history of Americans' relationship to nature.

California's Central Valley has attracted the attention of many scholars, and most have invoked the region as the antithesis of both romantic

agrarianism and enlightened environmental management. The valley's notoriety stems from its position as the most productive and the most industrialized of America's rural landscapes. Whether one's perspective is social or environmental, the valley's history can be told as the relentless domination of space by capital and technology. Social historians have chronicled the region's exploitative wage-labor system, its racialized workforce, and its history of violence. Environmental historians have found the valley's history equally appalling and irresistible: the large dams and fully engineered rivers constructed with no concern for their effects on fish and wildlife, the almost total obliteration of a native prairie and wetland landscape in favor of profitable crops, and the nearly unrestrained introduction of highly toxic pesticides and nonnative species. By any standard, the environmental changes have been immense. What most of these histories share, environmental histories in particular, is the idea of alienation and the theme of regret.[1]

The twin stories of capitalist exploitation and environmental conquest are not wrong. In fact, they are essential to understanding American—especially western American—history. In the words of Donald Worster, ours is "a culture and society built on, and absolutely dependent on, a sharply alienating, intensely managerial relationship with nature."[2] Worster is right. When we stand alongside one of the Central Valley's major irrigation canals, amid a landscape of engineered rivers, laser-leveled fields, and two-thousand-acre cotton ranches planted with genetically modified seed, the power of capitalism to shape the landscape, and the resulting sense of alienation, can seem at once undeniable and overwhelming.

Yet critiques such as Worster's suggest that there may be cracks in the metaphorical irrigation canal, that there are instances in which understandings of the landscape fall outside the rubrics of conquest and alienation that dominate so much of American environmental history. Perceptions of health and disease constitute just such a crack. Although they do not fall wholly outside the capitalist and managerial mentality, neither can they be fully contained within it. Thus, placing the stories of colonization and capitalist development alongside stories of health and disease creates a more complicated environmental history, one in which we can perhaps begin to see ourselves.

Such a story might be set anywhere, but I have chosen to return to the Central Valley, putting aside the classic narrative of regret to tell a less linear history of body and environment, health and place. Although California is most strongly associated with its coastline and its two



major cities, physiographically, the state is more accurately described as a very big valley encircled by mountains. The Central Valley is so big that it hardly seems like a valley when you are in it; it is roughly seventy-five miles wide and more than four hundred miles long. There is no other flat area of such size west of the Rocky Mountains. Although from a topographic perspective the Central Valley is a single unit, defined by the Sierra Nevada on the east and the Coast Ranges on the west, it actually comprises three different watersheds. The Sacramento and San Joaquin Valleys are defined by their rivers. The Sacramento River emerges from the mountains just north of Redding and flows south to the city of Sacramento, where it empties into a large delta and flows out into San Francisco Bay. The San Joaquin River flows out of the Sierra Nevada near Fresno and then runs north to the same delta. Immediately south of the San Joaquin Valley lies the Tulare basin—an area defined by the now-vanished Tulare Lake and separated from the Los Angeles basin by the Tehachapi Mountains. Although these watersheds differ from one another in important ways, their similarities bind them together in most people's minds. Since the late nineteenth century, the vast majority of the region has been devoted to agriculture, and by most measures, it remains the most productive landscape in the world. That productivity has been the outcome of many things: a warm climate, good soils, large groundwater basins, massive water engineering projects, and substantial state investments in mechanization, plant hybridization, and modern chemicals.

When I set out to write a cultural history of this environment, I found ample evidence of settlers' market orientation and belief in environmental conquest. Clearly they looked upon the western landscape as a resource ripe for exploitation, and they eagerly set about to mine the region's gold, harvest its timber, and plow up its prairies. But I also stumbled across settlers' overwhelming concern with the region's effect on their health, and here I found a different way of thinking about the land. Many immigrants to the southern California coast extolled its therapeutic effects, calling attention to the purity of the atmosphere, the temperate climate, and the healing properties of local springs. Settlers in the Central Valley, on the other hand, were far more anxious. They talked about miasma and poisonous north winds that left them feeling sluggish and debilitated, about dysentery and sunstroke, and also about a host of fevers—"bilious fever," "Sacramento fever," "autumnal fever," and "typho-malarial fever," to name but a few. But whether they experienced improved health or new forms of illness, settlers wrote about the


Map 1. The Central Valley of California, with the Sierra Nevada to the east and the Coast Ranges to the west.

environment and its effects in quite personal terms. These sources date from the mid-nineteenth century, the moment in which whites first migrated to California in substantial numbers. When these early immigrants surveyed their new home, they were as likely to discuss the prevalence of disease as the fertility of the soil. Physicians were among the keenest environmental observers, and their medical papers are filled with assessments of the landscape and its features: mountains, coastlines, and



valleys; swamps, soils, winds, and springs. The extent of this preoccupation surprised me, and I thought it might make for an interesting paragraph or two. Instead it reoriented my entire project, as I realized how important perceptions of health were to understanding the natural landscape in earlier eras.

These nineteenth-century discussions reveal that the development of the West's resources—the planting of the most profitable crops, the cutting of forests, the importation of cheap labor, the rapid adoption of technology—often ran up against settlers' concerns for their health. Put another way, the body, specifically the body's physical well-being, offered a powerful way of understanding local environments, a form of understanding that lay outside simple calculations of profit. These ideas had a more complicated history, and they pointed to a more intimate connection that settlers felt with the landscape. As Conevery Valenčius has put it, antebellum Americans "moved and breathed in profound connection with their environments."[3]

It is easy to dismiss nineteenth-century medical beliefs as a historical curiosity, as something that has no relevance to the more recent past. The voluminous writings on "sickly" and "salubrious" places suggest a deeply held fear of certain landscapes—swamps, forest edges, tropical climates. These fears were an outgrowth of Europeans' colonial experience and are no longer widely shared. Miasmatic disease, the quintessential environmental affliction of the nineteenth century, is now regarded primarily as an inadequate understanding of malaria, before medical science had revealed a mosquito-borne parasite as its cause. For many, the rise of "germ theory" at the end of the nineteenth century clearly separates the unscientific beliefs of earlier centuries from "modern" medicine and public health.[4]

What struck me about nineteenth-century health concerns, however, was that they were strange *and* familiar. While concerns over miasma and locally produced fevers are a product of a very different era, they seemed to resonate with and foreshadow late-twentieth-century anxieties about the environmental sources of cancer, asthma, and even the disputed disease of multiple chemical sensitivity.[5] Yet the rise of environmental health concerns in the decades after World War II has typically been portrayed as a wholly new development. Recent medical interest in environmental factors can be explained by pointing to shifting disease patterns (i.e., the decline in infectious disease and rising rate of chronic and noninfectious conditions) and to the material changes associated with America's rapid postwar growth (e.g., urbanization, rising rates of

air pollution). In this account "environmental health" has no connection to an earlier environmental medicine. But to emphasize the discontinuities in medical thinking may well be an artifact of modern medicine's desire, in David Morris's words, to "burn away the memory of its prescientific ancestors." In this book, I turn the story around. My question is not why and how the link between environment and health was finally recognized in the late twentieth century but why it had ever become invisible. From this perspective, the narrow situating of disease in the organic dysfunction of bodies and particular pathogens begins to look like a brief period of modernist amnesia.[6]

If we set aside the scientific narrative of medical progress, as well as the environmentalist narrative of regret, it becomes possible to trace continuities between the nineteenth and twentieth centuries. That concerns over environment and health persisted throughout this period, even in a paradigmatic modern space like California's Central Valley, suggests that connections and continuities deserve closer scrutiny. My story begins with the accounts of early-nineteenth-century immigrants and travelers to California, just before the initiation of large-scale American settlement in western North America, when humoral theory still dominated medical and environmental thinking. I show how nineteenth-century understandings of the body as porous and vulnerable shaped early responses to the California landscape and to the colonial project more generally. My story chronicles how physicians, boosters, and settlers drew on understandings of bodies and health to evaluate the diverse landscapes of California. In focusing on the diseases of the valley, I emphasize the growing tension between settlers' desire to rapidly transform the landscape for profit on the one hand and ecological understandings of health on the other.

Just as most histories of medicine and public health see the rise of germ theory in the late nineteenth century as a critical turning point, the turning point in my narrative also comes with germ theory—not, however, because it signaled the end of an unscientific environmental medicine, but because it marked the institutionalization of a certain concept of both the body and the environment. Advocates of the "new public health" defined health much more narrowly than their predecessors, as the simple absence of disease. And they insisted that disease-causing pathogens were situated in human bodies, not environments. Their models seemingly, and conveniently, resolved the tension between modernization and health by exonerating the landscape from any independent role in disease. Yet the discourse of germ theory obscured as much as it revealed, and, moreover, rhetoric did not always match practice. Sanitary engineers and entomologists, among others, remained attentive to the environment's role in disease; their daily practices undermined many of the modern premises that doctors and public health officials purported to embrace.



Immediately after World War II, public health specialists had to confront head-on the environmental sources of disease. The emergence of concerns about air pollution, radioactive fallout, and pesticides forced health professionals and laypeople to consider anew the interaction of bodies and environments and their definitions of health and illness. To tell this part of the story, I focus on the introduction of organic chemicals into the valley's environment and the concurrent emergence of concerns about pesticide poisoning among farmworkers in the 1950s and 1960s. In these decades modern conceptions of the body were publicly challenged by an ecological view that—much like earlier humoral medicine—saw bodies as intimately connected to their environments. With the rise of environmental concerns and the popularization of ecological science, bodies seemed as if they might once again be permeable and porous. Fearing the health effects of recent environmental changes, many middle-class Americans began to question the trajectory of their own modernity. The seminal text of modern environmentalism, Rachel Carson's *Silent Spring,* while popularly remembered as a book about the effects of pesticides on wildlife, centered on the dangers that newly introduced chemicals posed to human bodies.[7] In the Central Valley, farmworkers and environmentalists marshaled an ecological view of the body to challenge the models of professionals and to critique existing environmental and agricultural practices as inherently unsafe. In the decades after World War II, it became increasingly clear that human beings were not simply agents of environmental change; they were also objects of that change.

Unlike classic tales of either progress or decline, this history has no definitive ending or denouement because the dilemmas and conflicts that I delineate remain unresolved, even today. However, I take the story up through the 1980s by tracing conflicting ideas about the body, health, and disease as they played out both in the field of public health and in conflicts between health experts and laypersons. The final chapter describes the discovery of more widespread pollution in the valley and the ensuing debate over several cancer clusters and their possible environmental causes. These events reveal the resilience of models derived from germ theory in certain institutional contexts—even as both profes-

sionals and laypersons pointed repeatedly to the inadequacy of those same models.

By placing the human body at the center of an environmental history, this work challenges the modern dichotomy that separates human beings from the rest of nature, a dichotomy that underwrites the very discipline of history. By definition, history is about the ways in which human beings have shaped their world. Environmental historians, for their part, have sought to complicate that story by drawing attention to the role of plants, animals, soils, and climate. Nonetheless, environmental history has typically reinforced the modern dichotomy by placing humans and their creations on one side and everything else—nonhuman nature—on the other. In all histories, the actors are assumed to be human; the rest of the world is a set of constraints that human actors must work within.

When we focus on the human body, however, the boundary between the human and the nonhuman world, the actors and their objects, becomes much more fuzzy and the distinction much more tenuous. Where does the body end and "nonhuman nature" begin? When we recognize that human bodies are directly affected by their environments, we are forced to acknowledge that humans are not simply agents of environmental change but also objects of that change. Conversely, the environment is more than an object upon which change is enacted; it is also an agent of sorts that acts upon the bodies inhabiting it. As landscapes can be investigated to uncover the effects of certain human actions, human bodies—their symptoms and diseases—become sites for investigating the quality and effects of certain landscapes. Subjects blur into objects, and historical agency becomes distributed among a multitude of entities: humans, insects, microbes, trees, groundwater, and chemicals. It is no longer so easy to separate the human from the nonhuman world, to insist that modernity represents the triumph (for better or for worse) of humans over nature. Modernization was indeed enacted on the landscapes of North America but also—often unwittingly—on the people who inhabited those landscapes. It is a question not simply of how a manipulated environment has broadly influenced society but also of how environments have shaped human flesh in minute and profound ways. The history of disease, because it lies at the nexus of the human and the nonhuman, offers a useful means for rethinking these divisions and for reconsidering how we divide and write our histories—environmental, social, or otherwise.[8]

If environmental histories typically have ignored issues of health, it is also true that histories of health and the body typically have been told without reference to environments. Scholars generally write cultural and intellectual histories, including those of medicine and public health, in nonlocal ways. To the extent that these histories are located anywhere, it is usually in those institutions where ideas are codified and recorded: universities, government agencies, disciplinary societies. But to tell the history of health without reference to specific landscapes is to assume at the outset that landscapes do not matter. In fact, that has been the dominant assumption of twentieth-century medicine, and most of the field's historians have followed suit.[9]



But the history of medicine and health is also local. Though we tend to think of knowledge as residing in minds, knowledge and ideas do not emerge from nowhere but from the interaction of human minds with specific places, materials, and things. The contexts that shape knowledge are not only social and economic but also material and environmental. To take one example, knowledge about pesticide-related illnesses emerged first in the fields, as workers fell ill for unknown reasons. It was the subsequent investigation of local orchards and individual workers that began to reveal the complex relationship between chemicals and health. Once formulated, scientific ideas travel quickly, but they also continue to interact with actual environments and messy realities. Even the most abstract knowledge is ultimately produced from human experience in particular places; three decades of work in science studies have demonstrated that the modern scientific laboratory is its own kind of local space. Thus, in addition to highlighting the tension between the imperatives of capitalist modernization and the concern with health, this book engages the tension between local and translocal knowledge.[10]

In marked contrast to the modern laboratory, nineteenth-century medicine was determinedly and self-consciously local. Immigrant physicians brought with them to California ideas about miasma and warm climates, but they also expected to reformulate those ideas based on the diseases they witnessed and the soils, winds, and swamps they encountered. Twentieth-century medicine turned away from local knowledge, at least in theory, and highlighted the role of the laboratory. Yet even today we recognize that the history of health and disease is not fully divorced from place. The material qualities of a specific landscape remain critical to the production of certain diseases: local habitats that support anopheles mosquitoes, warm temperatures that allow the survival of parasites and bacteria, the material and biological conditions of particular human communities, the ability of local rivers to carry away

and dilute infectious sewage, the local history of chemical usage, the meteorologic and geologic characteristics that determine the fate of environmental toxins.

This tension between local and translocal knowledge often emerges in the materials produced by state and local public health officials, whose records provide an important set of sources for this book. From the early twentieth century on, public health has been an important arena for discussions of health and disease; moreover, public health professionals have held the power to regulate the relationship between human bodies and local environments. While committed to the professional discourses of biomedical science, public health officials have had to contend directly with local realities. Sometimes they found that local experience reinforced translocal knowledge about disease; at other times, however, they found that local experience challenged or resisted knowledge that had been generated elsewhere. California's public health experts, engineers, and environmental scientists have struggled over the decades to uphold the visions of a universal science, but again and again they have had to account for the particularity of environments and the idiosyncrasies of individual bodies. As Alan Irwin and Bryan Wynne have observed, "The local is the site of renegotiation of the 'universal.'"[11]

Any environmental history must confront the idea that the environment about which we write is, inevitably, something that we always understand through language and certain cultural practices. The chapters that follow pay close attention to understandings and perceptions: how people talked and thought about health, disease, and the environment. But like most environmental historians, I remain committed to a materialist view of the world. I am interested not only in how people talked about environment and disease but also in what happened on the ground—the changing pattern of disease, the changing uses of the land, the changing qualities of air, water, and soil. Consequently, I do not hew to either a materialist or a cultural approach, nor have I tried to separate out the two. That is precisely the point. Our understandings of environment and disease are shaped simultaneously by culture and by the material realities of the world. These stories need to be told together.

To talk about environmental changes in the valley, I rely on the understandings of contemporary science, which offer a powerful means of understanding past environmental and biological events. But while I evaluate earlier understandings of the environment or disease using modern scientific understandings at certain moments, that is not my



only—or even my principal—goal. I am not especially interested in ascertaining how much malaria might have been caused by nineteenth-century irrigation, or in how effective anti-insect campaigns were in reducing the prevalence of certain diseases. In many cases the historical record is far too incomplete to allow such an assessment. More to the point, I am only too aware that contemporary scientific understandings, however powerful they seem now, will inevitably give way to different or more refined interpretations. Contemporary scientific understandings are not the principal metric against which I measure the value of earlier ideas; rather, I try to understand those ideas on their own terms. Nonetheless, it would be foolish if not impossible to ignore what contemporary science has to say about the environments and diseases of the valley. Thus, I use scientific insights to make past events more understandable but do not assume that there is only one correct way to describe what happened. My point is that, like all narratives, scientific description is a product of its own time and place, shaped as much by past practices and prevailing attitudes as by empirical "facts." Contemporary science, like any other lens, simultaneously brings the past into focus and distorts it.

I treat the human body and its diseases in a similar fashion—as at once material realities and products of language and culture. Recent scholarship has insisted that the body, like the natural environment, cannot be taken simply as a biological given. People experience their bodies differently in different historical moments, according to the languages and practices available to them. And yet, as the historian Barbara Duden suggested some time ago, the body seems to exist in two kinds of time—historical and transhistorical. Though our experience of our own bodies is constructed by both culture and practice, there are elements of our bodily experience—including birth, death, fatigue, and symptoms of illness—that undeniably connect us to those who came before. Though there is no precise equivalence between the experience of "bilious fever" in the nineteenth century and malaria in the twenty-first, certainly many of the symptoms and effects that people experienced were quite similar. And though the experience of disease or even death is necessarily different in different times and places, in some ways it is clearly not.[12]

In this work, I emphasize two competing conceptions of the body. The first is what I will call for convenience's sake the "modern" body—the body of Western allopathic medicine and American consumer capitalism, the body that is defined in medical textbooks, the body that is composed of discrete parts and bounded by its skin; in other words, the idea of the

body that most of us take as so self-evident that it requires no comment. This idea of the body emerged only gradually. Certainly it existed no earlier than the eighteenth century, and in many places it developed much later or only partially. Its consolidation came only at the end of the nineteenth century with the rise of laboratory medicine. In Euro-American history, this modern body was preceded by a different, less than modern body that owed much to the writings of the fifth-century Greek physician Hippocrates. This older body was characterized by a constant exchange between inside and outside, by fluxes and flows, and by its close dependence on the surrounding environment. Using contemporary terms, I label this earlier conception of the body "ecological," though it clearly antedated the modern science of ecology. Until the late nineteenth century, the concept of health typically referred to a state of balance, or harmony, between a person's body and the larger world. In contrast, for the modern body, "health" came to connote primarily the absence of disease; it implies both purity and the ability to fend off harmful organisms and substances. Above all, health became a quality possessed (or not) by an individual body rather than a dynamic relationship between a body and its environment.[13]

To label different conceptions of the body "ecological" and "modern" is obviously an oversimplification—but a useful one. It calls attention to certain continuities and differences. The critical difference between the two in my account is the quality of permeability: that is, to what extent and by what means a body is closed off from the larger environment. While I track the occurrence of certain diseases, I also trace the construction of bodies as more or less permeable to their environment in different times and places. The move toward bacteriological theories of disease in the late nineteenth century marks an important if incomplete shift in this respect. Initially, those who embraced germ theory melded the new ideas with their long-standing environmental beliefs; ecological and modern concepts of the body coexisted openly and easily for some time. Nineteenth-century physicians were likely to see germs everywhere and capable of penetrating the body in many ways. However, the increasing dominance of bacteriology encouraged doctors to narrow their definitions of health and to limit their focus to the specific pathogenic agents that were revealed under the microscope. Gradually, they reinterpreted health as the absence of disease and disease as something confined to discrete entities. By the early twentieth century, advocates of the "new public health" were confidently proclaiming that the skin protected a body from its surroundings and urging their colleagues to shift their attention away from the environment; what mattered now was shoring up the self-contained body.[14]



What the existing scholarship has overlooked is how this shift from an ecological to a modern conception of the body affected understandings of the environment. In the rhetoric of public health, local environments were no longer understood as active components in the production of health and disease; instead, they were recast as homogeneous spaces that were traversed by pathogenic agents. In this formulation, the environment itself (aside from pathogenic bacteria) had no agency of its own in the production of disease. But that narrowed focus was always belied by actual public health practices and by the persistence of other, more environmentally oriented medical subspecialties. In the years after World War II, the modern concept of the body was strongly challenged by new types of illness. When investigators began to research pesticide poisoning in the 1950s, they found that bodies were far more porous than they had previously acknowledged and the local environment far more implicated. Once again, the skin was less a boundary than a zone of transfer and connection. The singular and self-contained human body of the early twentieth century came, by the end of that century, to seem distressingly porous and vulnerable to the modern landscape.

Any discussion of the body and its diseases cannot be understood without reference to the complex history of race. The relationship between bodies and environments in Euro-American culture has always been racialized, like the bodies themselves. Although race is an arbitrary category that has no firm basis in modern biological science, it has been an overwhelmingly powerful and persistent idea with vast material effects; the very indeterminacy of the concept has spurred tremendous efforts to make it seem more real. In the eighteenth and nineteenth centuries, ideas of race, scientific and otherwise, stood at the center of Euro-American understandings of body and place. Colonial discourse insisted that races were associated with particular places and that "race" itself was both an outcome of location and the principal determinant of one's fitness for any particular land. Until the late nineteenth century, most Euro-Americans believed that it was the very permeability of the body that created its race and that a person's race was liable to change in a new location. Careful scrutiny of the land and its bodily effects provided an important arena for the ongoing construction of race and racial ideology. As Europeans moved into new areas of the world, they often found themselves highly susceptible to disease and death, considerably more

susceptible than the natives of those areas. That physical vulnerability would find expression in the European fear and denigration of hot, tropical climates as places inherently hostile to civilization. In the nineteenth century, as Americans embarked on their own project of expansion, many still feared that the western portions of North America might threaten their racial identity and undermine their colonizing project. The heat and diseases of the Central Valley in particular suggested its similarity to "tropical" locations and thus its inherent hostility to white bodies and Euro-American culture, and the process of white settlement generated a far-reaching discourse about environment, race, and health that linked the environments of California with those of other colonial frontiers in Asia, Africa, and Latin America.[15]

Although climatic theories of race would give way in most quarters by the turn of the century, the category of race still remained central to discussions of disease and health. In the first half of the twentieth century, the link between race and disease was reformulated through appeals to bacteriology. People of certain races were no longer perceived as more or less suited to specific environments; nonetheless, certain races were deemed more likely to "carry" disease into otherwise healthy locations and to be more susceptible to certain kinds of illness.

After World War II, overtly racist thinking lost much (though certainly not all) of its power in biomedical discourse, but the social and economic inequality fostered by racism meant that race and disease would continue to map onto one another. Those who were not "white" were more likely to suffer from specific illnesses and to lack many of the characteristics that signified good health. For some, this remained evidence of the susceptibility of certain kinds of bodies and the bad habits of certain kinds of people. For others, however, it pointed to the fact that socioeconomic inequality had a geographic, and environmental, dimension. A long history of residential and employment segregation meant that nonwhites were far more likely to live in badly polluted communities and to have more hazardous jobs.[16] In the late twentieth century, the health status of minority communities became a crucial political issue that would underwrite calls for "environmental justice." Whereas colonial science had understood the relationship between disease and race as one that potentially set limits on the colonial project, late-twentieth-century activists argued that that relationship required Americans to acknowledge and contain the unequal effects of their modernization. Although the relationship between race and disease has been continually reformulated, the linkage remains remarkably and distressingly persistent.[17]



Of course, my own intellectual practices and concerns influenced the narrative long before I entered the archives. And while I believe that all understandings are contingent, partial, and situated, underlying my own practice is, admittedly, the belief that our bodies powerfully affect and depend on the environments they inhabit, that the changes we make in the land will ultimately be registered in ourselves and in those who follow us in very material ways. This is the belief that underwrites my entire project; otherwise, this book would make no sense. And yet those linkages may be understood in multiple ways, or even not at all. A major part of the story here is about when and how the links between environment and disease are made visible or invisible, a tracing of the cultural and intellectual practices, my own and others', that connect or disconnect the health of bodies and the condition of the landscape, and the ensuing social and political implications.

# 1

# Body and Environment in an Era of Colonization

A knowledge of the *etiology of diseases* can best be attained by studying the affections of different localities in connection with every condition and circumstance calculated to operate prejudicially or otherwise upon the health of the inhabitants. Such philosophical investigation is particularly useful in tracing the modifications diseases may undergo from the agency of causes of a local or special character; and being also calculated to elucidate the relationship of diseases to climate, to the prevailing geological formations—the fauna, the vegetables, the minerals, the waters, which vary with the earth's crust, wherever man can make his abode, commends itself to the pioneer physician of our extended territory.

Dr. Thomas Logan in *Transactions of the American Medical Association*, 1859

It is typical to think of the colonization of western North America as a process in which Europeans and Americans remade the land by reworking natural environments into forms that were both aesthetically pleasing and materially useful. This is surely true, but it is also true that in earlier eras Americans understood colonization as involving bodily transformation as well. The process could work both ways. Places could alter bodies as much as bodies could alter places. Despite the political and cultural rhetoric of conquest, those engaged in colonizing western North America recognized that the effort often brought substantial physical risks. Western immigration was a gamble in physical, as well as economic, terms.

Historians of American expansion have not neglected concerns about health; however, they have overwhelmingly emphasized the disease experience of Native Americans. The story of "virgin soil epidemics"—the





transmission of European diseases to Indian populations with no previous exposure and thus no acquired or inherited resistance—is now quite well known. That the consequences of European disease were horrific for most Indian peoples is certain. But Indians were not the only people who suffered extensively from illness in the eighteenth and nineteenth centuries. The processes and exchanges brought about by the colonial endeavor of that period created what one scholar has labeled a "global epidemiological crisis." Everyone was more vulnerable to illness, even those who stayed put. Diseases that were already familiar to white colonists were not necessarily less debilitating or frightening on that account. Accordingly, concerns about disease and disability permeated much of nineteenth-century European and American culture.[1]

The focus on the disease experience of Native Americans is justified by the unprecedented scope of Indian depopulation and the role that illnesses played in that catastrophe. But to ignore the disease experience of white immigrants is problematic. Such a selective focus can in some cases serve to retrospectively naturalize Euro-American colonization. What was historically contingent—European dominance in North America—can come to seem biologically predestined, and the centuries-long struggle between native peoples and Euro-Americans, which was marked by incredible violence, can too easily be rewritten as a passive and unavoidable conquest. The historical "forgetting" of disease, other than the diseases of Indians, may itself be part of a centuries-long process of normalizing white colonization in the western United States.[2] Moreover, by failing to acknowledge the perceived vulnerability of white as well as nonwhite bodies in earlier periods, we run the risk of reading those periods through the lens of later demographic transitions. By contrast, those engaged in colonization were often far less certain of its ultimate outcome, particularly as they waged their own struggles with Native Americans, unfamiliar landscapes, and a host of lethal diseases: cholera, malaria, dysentery, typhus, yellow fever, tuberculosis.

Understanding the health concerns of nineteenth-century settlers in western North America requires that we put aside more recent understandings of both the human body and the environment. The one-sided focus on the disease history of Indian peoples can have the effect of rewriting white bodies in contrasting and somewhat ahistorical terms—as clearly bounded, always resilient, and unproblematically cosmopolitan. But this modern understanding of the body cannot be found in early- or even mid-nineteenth-century sources. In fact, the very idea of a distinct and bounded body, clearly separate from its environment, and able to move unproblem-

atically from one location to another, is a relatively recent historical development. Nineteenth-century bodies, white and nonwhite, were malleable and porous entities that were in constant interaction with the surrounding environment, an environment that retained a complex agency of its own. Disease in the nineteenth century, even when acknowledged to be contagious, was not reducible to specific pathogenic agents or person-to-person contact. Contemporaries understood the causes of disease as spread widely across both bodies and landscapes. Consequently, prospective settlers approached new environments with caution, recognizing that the land itself could be either a font of health or a source of illness.

For those who moved west, human bodies were the most sensitive and reliable indicators of place.[3] The presence or absence of certain illnesses, rates of birth and death, and the course of epidemics—all these were important clues to the qualities of an unfamiliar landscape. Settlers and travelers alike were typically attuned to the reactions of their bodies and to the appearances of those they met. Their physical reactions—the onset of fever, a new sense of vigor, a persistent cough, the timing of menstrual cycles—became important means to understand new places. As settlers set about to alter the landscape, they recognized that the landscape, in turn, might also alter them. Settlers' bodies were thus instruments of colonialism in a double sense—in that they both facilitated the colonial project and registered that project's physical effects. Nineteenth-century American medicine eagerly addressed itself to this project, assessing both bodies and landscapes with an eye toward preserving health and whiteness in new locations.

## COLONIZATION AND HEALTH

Today California is commonly, even prosaically, associated with health. In our own health-obsessed time, California stands out as an especially health-obsessed place. But the rhetorical association of California and health was largely a creation of mid-nineteenth-century western boosters. Firsthand accounts of the period offer a much more equivocal and sometimes negative picture. Until the late nineteenth century, California, in European and American minds, was a distant frontier about which little was known, a "terra incognita" as more than one source referred to it. Although California may not have raised the same level of fears among Euro-Americans that southern Africa or the Caribbean did, we should not then assume that early migrants to the Far West understood their relocation in trivial terms.



In the Spanish and Mexican colonial periods, Alta California's colonizers and explorers did not consider it a particularly healthful place. There is no obvious reason why they should have. The existence of disease among Indians in California is indicated in part by their extensive knowledge of therapies, which early European observers simultaneously derided and recorded. Among those native remedies that Americans adopted were *Eriodictyon californicum* (yerba santa), a treatment for bronchitis; *Rhamnus purshiana* (cascara sagrada), a well-known cathartic; and *Grindelia robusta,* used for both lung and skin diseases. By the eighteenth century, Indian peoples were also dealing with an onslaught of new diseases. Scholars have typically assumed that European diseases emerged in California only after the establishment of the first Spanish mission in 1769, but some diseases may have preceded colonization. There is no question, however, that disease arrived anew with the Spanish. Contemporary scholars concur that venereal diseases (both syphilis and gonorrhea) were rampant among the Spanish and the mission Indians and had spread to the tribes of central California by 1814.[4]

Venereal diseases were the most prevalent but hardly the only old-world illnesses in colonial California. In the early nineteenth century Franciscan missionaries reported the presence of consumption, dysentery, and various fevers. A devastating measles epidemic swept the missions in 1806 and may also have spread beyond. Smallpox probably arrived in 1828. In 1837 a smallpox epidemic broke out at Fort Ross on the northern California coast and moved south, killing more than 2,000 individuals mainly among the Pomo, Wappo, and Wintun. Another epidemic began in 1844 among settlers in the Central Valley town of Stockton; it subsequently spread through the valley and foothill regions, affecting mostly the Miwok. In addition to smallpox and measles, pneumonia, diphtheria, scarlet fever, and tuberculosis were recorded in California prior to the 1840s. Disease undoubtedly played a critical role in the decline of the California Indians. The demographer Sherburne Cook estimated that Indian numbers dropped by 21 percent between 1770 and 1830, from more than 300,000 individuals to approximately 65,000. Declines were far higher in the missions than elsewhere, a reflection of both a more concentrated population and the oppressive and often violent nature of mission life.[5]

The few medical men who attempted to assess the health of California in the Spanish and Mexican periods were circumspect. In 1786 the physician Henry Rollin accompanied a French expedition to California and published an account of the voyage in Paris eleven years later. Rollin

cataloged the various diseases suffered by California Indians, which he attributed largely to the "great changes in temperature" during the year. He listed several diseases as prevalent in the region, including "ephemeral and intermittent fevers," "digestive disturbances," "putrid fever," "petechial fever," "bilious fevers," and dysentery, neuritis, rheumatic "affections," scabies, opthalmias, pox, and epilepsy. Rollin laid special emphasis on the "high fevers" and "bilious fevers," which he noted were widely feared and frequently fatal.[6]

Among the Spanish, the only professional physician in Alta California was the surgeon general stationed at the provincial capital of Monterey, a position that was evidently difficult to fill. Of the eight men who occupied this position between 1769 and 1824, few left significant records. However, in 1804, at the behest of his superiors, who were concerned by the exceedingly high mortality among mission Indians, Dr. José Benites wrote a lengthy report summarizing the medical condition of the province. He reported that syphilis, scrofula, and tuberculosis were common illnesses. He also made reference to the region's unfavorable climate: the humidity, heavy fogs, and great cold, all of which he believed were contributing to the prevalence of disease. Authorities in Mexico City had little interest in supporting Benites's principal request—that they establish a hospital at Monterey. Instead the Royal Medical Board noted somewhat fatalistically that disease in Alta California was unavoidable because of "the extreme cold, the lack of shelter, the bad water, lack of vegetables, and badly prepared meats," as well as the "voluntary indiscretions" of the inhabitants. Impressions recorded at about the same time by George Heinrich von Langsdorff, a surgeon accompanying a Russian expedition to California, were more favorable. While Langsdorff found the west coast of Mexico unhealthy in the extreme, he reported that the climate of Alta California was "better and more salubrious." But he was hardly enthusiastic on that point, noting that the local Indians were often afflicted with fevers, measles, venereal diseases, and a mysterious palpitation of the heart.[7]

As these sources indicate, disease was a constant presence in the region by the early 1800s, if not before. Several epidemics swept through California in these decades, including at least three severe outbreaks of smallpox.[8] Yet, by all accounts, a different and especially devastating illness appeared in the California interior in the 1830s. Indian tribes throughout central California were catastrophically affected, as were the few white settlers and travelers in the region. John Work, an Irish immigrant who had settled in Canada and the leader of a Hudson's Bay trapping expedition to central California, was one of those who fell ill in the summer of 1833; Work's journal offers a firsthand account of the disease among both local Indians and members of his party.



WEDNESDAY 31 [JULY 1833]

Several of our people have been for some days unwell and some symptoms of the fever breaking out among them.—Indeed for a length of time back, the weather has been very unfavorable for health. The heat, except for a few days back excessive during the day and a heavy chilly dew in the night, so that our blankets would be completely wet in the morning as we slept in the open air. Besides we often had very bad water.

TUESDAY 6 [AUGUST 1833]

Some sickness prevails among the Indians on feather river. The villages which were so populous and swarming with inhabitants when we passed that way in Jany or Febry last seem now almost deserted & have a desolate appearance. The few wretched Indians who remain seem wretched they are lying apparently scarcely able to move. . . . We are unable to learn the malady or its cause.

TUESDAY 20 [AUGUST 1833]

Our sick people get no better, nine more have fallen ill within these two days, making in all 61 that are ill, a good many of them attacked with trembling fits. . . . Our condition is really deplorable, so many of the people taken ill and no medicines, fortunately not many of the men are yet ill, but is is to be apprehended they soon will fall and that we will soon become so weak that we will not be able to raise camp, and I am afraid to stop lest we die like the Indians the most of the people completely disheartened, and indeed well they may.—I endeavour to keep up their spirits as well as I can but it is become now of little effect.[9]

Four days later Work reported that seventy-two persons were ill out of a party of one hundred, and over the next two and a half months, several died. "Our whole party is now become exceedingly helpless," Work wrote on September 7. At the same time, the death toll among resident Indians was almost incomprehensibly high. Of the Indians in the northern Sacramento Valley, the Wintun, Work noted that "the villags *[sic]* seem almost wholly depopulated." Later accounts confirmed the magnitude of the epidemic. An American trapper, J. J. Warner, recalled of the once densely populated region that every native village along the rivers had been abandoned and his party saw "but one living Indian." A member of the Yokuts tribe told the ethnographer Stephen Powers in 1872

Figure 1. A rancheria near Yuba City, in the area where the 1833 malaria epidemic devastated Native American populations. From *Gleason's Pictorial* 13 (27 March 1852): 96. Courtesy California Historical Society, FN-4341.

that a plague had raged throughout the San Joaquin Valley several years earlier, destroying "thousands of lives." On October 31, 1833, Work finally made it back to Fort Vancouver. As he described his condition some years later, "I was so much exhausted by this debilitating disease that I was reduced to a perfect skeleton and could scarcely walk."[10]

Modern scholars interpret this event as an epidemic outbreak of malaria and typically trace the origins of the disease in central California to Work's own party, though malaria may have appeared in conjunction with influenza, which could explain the dramatically high death rates. While malaria is not generally believed to have been endemic to California before the nineteenth century, at least four species of anopheles mosquitoes were. Once what we now understand as the plasmodium parasite was introduced into California, it could spread through those regions that supported large numbers of anopheles. Moreover, the temperate climate and long, hot summers of California were conducive to an epidemic outbreak, as they fostered multiple cycles of mosquito reproduction. The disease, or diseases, that reached California in 1832 were the southern extension of an epidemic, most likely of vivax malaria, that had begun on the lower Columbia River in 1830, at Fort Vancouver. The epidemic had a devastating impact on the Chinook and Kalapuyan peoples in the Pacific Northwest, prompting one contemporary scholar to label it "the single most important epidemiological event" in the



recorded history of the region. By the time Work's party left Vancouver, malaria had apparently infected most of the white population in the Northwest, and, in fact, Work reported that several of his party became sick with "intermittent fever" en route to California. Disease then traveled south from the Columbia in the bodies of the trappers and their families. Its overall effect on the Indians of California was as terrible as it had been on the Indians of the Northwest. In 1955 Cook estimated Native American mortality in California at 20,000; however, he later revised that number upward to 50,000, or what he estimated to be one-half the entire Native American population in central California. Though the numbers cannot be determined with any accuracy, it is clear from contemporary accounts that the epidemic radically disorganized California Indian societies, leaving Indian peoples ill prepared to resist or adapt to the dramatic invasion of their territory that came a decade and a half later with the discovery of gold.[11]

But the impact of the epidemic on Indians should not obscure the fact that whites themselves were highly vulnerable to malaria and often incapacitated by it—as the fate of Work's expedition attests—though they were typically less likely to die.[12] Malaria, which remains a significant global problem, was the preeminent disease of the nineteenth-century frontier. Fear of the intermittent and remittent fevers were shared by all western colonists, as well as by those who were long settled in the southern states. Even where death rates from malaria alone were not high, it often debilitated much of the population and complicated other, more fatal illnesses. The disease spread rapidly in mosquito-ridden areas such as central California and could easily infect an entire community.[13]

Such contemporary diagnoses were, of course, unavailable to either the Indians or John Work. Mosquitoes were an ongoing nuisance to Indians and whites in California, but no one had reason to think them a source of illness. Indians generally interpreted disease as a foreign or hostile object that had entered the body, the result of an offended or malignant spirit. To cure the ill, these disease objects or "pains" had to be extracted from the body. For most Indian groups in California, the preferred cure was a bloodletting ceremony performed by a shaman, often in combination with specific medicines.[14] Work, on the other hand, drew on Euro-American frameworks of disease. He believed his party suffered from two diseases—a mysterious fever that caused violent headaches and intense pain in the bones and the more familiar "ague," or intermittent fever. European cures for fever and ague were similar to those of many Indian tribes and included both bloodletting and quinine.

Yet having neither medicine nor a doctor in his party, Work sought a change of climate and location. He urged his exhausted and discouraged companions to continue, believing that once they reached the mountains they "would experience a difference of climate which would most likely effect a change for the better."[15]

Work was clearly desperate to save himself and his party, and in seeking a "difference of climate," his response was consistent with the medical advice of his day. In the nineteenth-century world, bodies were understood differently than they would be in the next century. Professional and popular beliefs about health derived from humoralism—a system of medicine that held health was the outcome of balance among the essential bodily fluids, or "humors." Though the idea of humoralism may seem bizarre to most contemporary Americans, in slightly different forms humoralism was the basis for Western medicine from the time of ancient Greece until nearly the end of the nineteenth century. In contrast, the history of "modern" Western medicine and the corresponding "modern" body is far more brief. These ideas would come only with the bacteriological discoveries of the late nineteenth century and their institutionalization in the twentieth.[16]

Before the late nineteenth century, a healthy body was a body in equilibrium, and disease signified that balance needed to be restored. Composed of flows and fluxes—of blood, mucus, saliva, feces, perspiration—the body could easily be either over- or understimulated. The result was imbalance, and the likely outcome was illness. An improper diet, poor habits, a shock to the system, mental anguish—any of these might push a body out of kilter. But especially important were changes in the external environment. Changes in temperature, winds, humidity, or simply an unfavorable landscape could alter the body's normal functioning and leave it prone to a variety of ailments. Work connected the onset of disease among his party with weather that was "very unfavorable for health." Similarly, an army surgeon reporting on the health of the U.S. troops stationed in the California desert in the 1850s wrote that the "unusual mortality" witnessed at his post was "attributable to but one cause, viz.: their transfer from a comparatively cold climate to one so much warmer and more debilitating."[17]

For nineteenth-century Americans, the body itself was not a clearly bounded entity, separate and distinct from its surroundings; rather, it was porous and permeable. The skin did not close off an individual, separating him or her from the larger world. The body flowed into the environment, and the environment seeped into an individual body—through



the air one breathed, the food one ate, the water one drank. These interactions were not only unavoidable; they were critical to health as well as illness. External surroundings could shape the body in both subtle and profound ways. A given environment inevitably left its mark in a body's shape, color, and strength, while radical changes in a person's environment could effect wondrous cures or induce sudden illness. The prevailing winds, the onset of floods, a local earthquake, a distant volcanic eruption—these might all be factors affecting an individual's condition. Local surroundings might be managed for better health, but they could never be kept at bay—nor would one want to do so. Health was not the product of successfully closing a body off from external influences but of intelligently managing the relationship between an individual and his or her surroundings.[18]

This ongoing concern with the environment does not mean that nineteenth-century individuals were oblivious to the process of contagion. Quite the contrary. By the end of the eighteenth century, Spanish measures to prevent the spread of smallpox included isolation, quarantine, and inoculation—which may well have stemmed the spread of several epidemics known to have ravaged Mexico and the Southwest.[19] Moreover, throughout most of the nineteenth century, a heated and sometimes vitriolic debate raged between those physicians who advocated "contagionism" and those who held to the doctrine of "anticontagionism." And though it is easy to interpret this debate through the lens of later scientific developments—and thus to read the "contagionist" position as a forerunner of germ theory—such a reading erases an earlier context. The very ideas of contagion and infection held different meanings than they would in the following century, and they were not necessarily incompatible. Part of what makes eighteenth- and nineteenth-century sources so opaque to a modern reader is that the categories that are so meaningful to us—contagious versus noncontagious, infectious versus chronic—were neither crucial nor discrete distinctions in earlier eras. Even when these words were employed, their meanings differed from contemporary usage. Although the most extreme anticontagionists, such as the well-known Philadelphia physician Benjamin Rush, suggested that there were but two opposed ways of understanding any given disease, most medical men embraced a more complex position. For instance, a Spanish directive on smallpox issued to the governor of California in 1786 emphasized the need for quarantine. But while acknowledging that most professional men believed the disease was transmitted by "contact with the victims or the houses in which they are

treated," the writer nonetheless insisted that victims should be quarantined "in a healthy location [that] shall be situated so that the prevailing winds in the region cannot communicate the contagion to the villages and farms of the vicinity."[20]

A report on disease in California published in the 1860s reveals the slipperiness of medical categories. The writer divided epidemic disease into three classes: "contagious" (which included smallpox, scarlet fever, and measles), "meteoratious" (diseases that were contagious to a limited degree), and "infectious" (diseases "assumed to possess the property of propagating . . . by means of a vitiated or poisoned atmosphere emanating from and surrounding the diseased person, without contact of the body or clothing"). Moreover, he elaborated the difference between contagious and meteoratious epidemics in the following way: "The great majority of cases [of contagious disease] spring immediately from specific poisons, generated in primary or atmospheric cases, and communicable from one individual to another. Whereas in meteoratious epidemics, excepting in one or two of them, every case is of atmospheric *origin;* and, in the exceptionable instances, as in the cholera (and to which may be added diphtheria), which is believed to possess the contagious attribute, the great *majority* of cases manifestly arise, not from the diffusion of its contagious virus, but from the existing meteoratious influence." Implicit in this description was an acknowledgment that the distinctions between these categories were anything but firm. Certain diseases, notably smallpox and syphilis, were widely held to be transmitted from person to person. Even so, contagious diseases might have an atmospheric origin, while meteoratious epidemics might have contagious "attributes." Contagious disease shaded into environmental disease and vice versa.[21]

Despite the recognition of contagion, the local environment was always regarded as critical to health or illness. In the words of the historian Charles Rosenberg, "Disease entities played a relatively small role in a scheme that emphasized the body's unending transactions with its environment."[22] On the other end of the spectrum from smallpox were various fevers, nearly all of which were understood to originate from local places and were thus labeled "endemic." Yet epidemics were also understood to have local causes, for that offered the most logical explanation for why so many people in one place became ill at the same time. Still other diseases such as diphtheria and yellow fever were believed to emanate from environmental causes but were liable to become contagious, depending on the circumstances. And most physicians concurred that even "contagious" diseases, such as smallpox and plague, had



important "climatological relations." When smallpox broke out in California in 1868, leading California physicians readily acknowledged its contagious character and argued for vaccination, but nonetheless they believed that both local and global climatic conditions were relevant to the course of the epidemic. As Thomas Logan put it, "There is some peculiar, but as yet inscrutable condition of the climate which favors its development." Another California physician, Frederick Hatch, offered the hypothesis that climatic conditions, "having brought about such modifications in the constitutions of our people as to renew a susceptibility to the agent," might explain the failure of vaccination to protect against smallpox that year.[23] These and other writings reveal understandings of causality that are multiple; environmental explanations easily overlap with theories of contagion. Disease always had many potential sources, both human and nonhuman.

## MAPPING THE DISEASE ENVIRONMENT: MEDICAL GEOGRAPHY

Nineteenth-century writings about disease offer a window into earlier conceptions of the body. Perhaps less obviously, these same writings speak to earlier conceptions of the environment. Different conceptions of illness point to differences in how people have understood the nonhuman world. When viewed from the perspective of health, the nineteenth-century environment was neither passive nor necessarily benign in its natural state. To the contrary, the "natural" environment, especially those environments least touched by the processes of civilization, acted on settlers' bodies in sometimes aggressive and unpredictable ways. Consequently, untested landscapes were always physically threatening. This fear of distant and unfamiliar places generated reams of popular advice for would-be settlers and travelers. At the same time, existing medical and scientific practices brought the environmental sources of disease into focus.

Interest in the medical effects of certain environments has a very long history, dating at least to the Greek physician Hippocrates and his treatise *Airs, Waters, and Places,* written in the fifth century B.C. Theories of environmental causation gained particular prominence in seventeenth- and eighteenth-century Europe. In that period several European intellectuals drew on Hippocratic ideas to articulate a discourse that denigrated warm places and their inhabitants. Among the most influential was Montesquieu, who, in *The Spirit of Laws* (1747), famously argued that hot climates produced sloth, excessive sexuality, and despotic forms of

government. This view would be widely held in Europe for at least the next century. Only in the 1900s, however, would the professions of medicine and geography scientize these beliefs. For both Europeans and Americans, the project of colonial expansion fostered the new disciplines of medical geography—which studied the large-scale distribution of diseases across continents—and medical topography—which cataloged the physical factors that affected health in certain localities.[24]

What motivated these inquiries was the desire to explore and colonize new environments. Medical geography implicitly and often explicitly served the needs of European colonialism. Many of the earliest medical topographies emerged from various militaries out of the concern for troop mortality in distant regions, and, not surprisingly, it was British physicians who did the most to systematize the geographic approach to disease. The British colonial project had generated an obsessive interest in the "tropics" as a zone of overabundant nature that was inherently inhospitable to European "civilization," and these emerging ideas about "tropical" environments owed much to European fears of disease. The canonical English texts on environmental medicine in the nineteenth century were James Lind's *Diseases Incidental to Europeans in Hot Climates,* published in 1768, and James Johnson's *The Influence of Tropical Climates on European Constitutions.* Johnson's volume chronicled the diseases experienced by Europeans in so-called tropical lands: India, Asia, Batavia, southern Europe, western Africa, and the West Indies. First published in 1812, the book had reached its sixth edition by 1841, a testament to its influence. It would remain the principal reference on the subject for two more decades as it was expanded and edited by another British colonial physician, James Ranald Martin.[25]

Though their work on climate and disease was separated by more than seventy years, Lind and Martin occupied a similar intellectual milieu. For both authors, health was the result of humoral balance in the body, and warm climates were likely to overstimulate the temperate European constitution. Excessive heat, especially temperatures that exceeded that of the body, predisposed an individual to all kinds of diseases. Prevailing medical opinion held that the greatest effect was felt on the liver, which produced irregular secretions until, exhausted, it ceased to function adequately. The texts themselves were both diagnostic and prescriptive, offering not only a chronicle of disease and its symptoms but also suggestions on how Europeans might lessen the impacts of hot climates on their selves (through rigid temperance and prophylactic measures). The message was that European bodies were highly sensitive



to relocation and required careful observation and intensive self-management in unfamiliar and inherently hostile places. In the case of serious illness, however, the best and often the only hope lay in returning to a more temperate climate. As Johnson wrote, a change of locality was frequently "tantamount to a transition from almost hopeless disease to rapid recovery."[26]

German and French physicians also contributed to the development of a global geography of disease. Especially important to the continental versions of medical geography was the work of Alexander von Humboldt, who is considered the founder of scientific geography. Humboldt sought to understand the natural world by collecting quantitative information about various landscapes and then seeking mathematical correlations among the variables he had measured. His most significant contribution to physical geography was the isothermal map—a cartographic representation that linked regions by their average temperatures. Humboldt noted that these lines of average temperature, along with altitude, set limits on the occurrence of certain plants, and he produced numerous maps of the world that charted distributions of flora. He also suggested that, like plants, certain diseases were produced under specific conditions of temperature, humidity, and altitude. It was this observation that medical geographers, Germans in particular, took as their starting point. They sought to map the spatial distribution of disease in the same way that Humboldt had mapped the distribution of plants. Like their mentor, medical geographers looked for correlations between the occurrence of disease and measured characteristics of the landscape. Practitioners held out the hope that with the collection of enough data—temperature, barometric pressure, rainfall, and so on—they would be able to predict the response of human bodies to diverse environmental conditions.[27]

At root, the primary concern of nineteenth-century medical geography lay in preserving the health of the white race in unfamiliar lands. Behind the desire to uncover the relationship between bodies and landscape lay the belief that the success of Europeans had always hinged, to some undetermined extent, on climate and, moreover, that climate might ultimately set limits on their continuing colonial ambitions. Nineteenth-century Europeans and Americans understood race in multiple and contradictory ways—as variously a sign of biology, nationality, and culture. A concept anchored in incoherence, race necessarily eluded precise definition. Yet it was quite clear to contemporaries that race was associated in some way with place. Whites came from Europe,

blacks from Africa. The yellow race originated in Asia, the red in America. Race always had a geographic component, and thus it is hardly surprising that ideas of race played a central role in nineteenth-century medical geography. After all, the question that most interested European medical geographers was whether those of northern European descent (i.e., whites) could survive and prosper in climates that they associated with "other" races. While there was general agreement that strange environments had negative effects on European bodies, contemporaries debated the extent to which those same bodies might adapt and acclimatize to their new surroundings.[28]

Proponents of acclimatization believed that human bodies could, over time, adjust to new surroundings. As Europeans had succeeded in introducing plants and animals to unfamiliar regions, they argued, the same would be true for transplanted peoples. But theories of human acclimatization had many opponents. For most who argued against acclimatization, the central issue was racial malleability. If European bodies could in fact physically change to survive in a new climate, would they still be European? More to the point, would they still be white? As James Johnson put the question in his medical treatise of 1820, "Will it be said, that the fair complexion of Europeans, may, in two or three generations, acquire the sable tinct of the inter-tropical natives, by exchanging situations?"[29] By answering with an unequivocal "no," Johnson adhered to a belief in racial stability; whites would remain white no matter where they resided. But Johnson's was hardly the last word on the issue. The question would continue to preoccupy European and American intellectuals for the rest of the century.

The concern with whiteness and its potential malleability was paramount in European settler societies. The "frontier," whether in Africa or North America, was never a zone that separated empty from populated lands; it was, however, a zone that separated lands dominated by those identified as "white" from those whom they deemed nonwhite. By definition, frontiers posed challenges to racial identities; their miscegenated populations only underscored the problem. In a period in which place helped to produce ideas of race and bodies were perceived as porous and5permeable, migration always threatened racial identity as well as health.[30]

Even the suitability of North America for European immigrants had been an issue of long-standing debate. In the seventeenth century, British settlement in America was accompanied by considerable fears over health, especially in the southern colonies but also, to a lesser extent, in



New England.[31] In the late eighteenth century European and American elites intensely debated theories of climate and civilization. Among the most influential authors on this point was Georges-Louis Leclerc, Comte de Buffon, who argued that the cold, humid climate of North America could not support plants and animals of the same size and quality as those in Europe. Pointing to the absence of large native mammals—such as the giraffe, the hippopotamus, and the lion—and to the degeneration of European livestock in the new world, Buffon argued that North America produced neither the same quality of person nor the high level of civilization that existed in Europe. The evidence for this lay in Buffon's description of the physical inferiority of Native Americans—their lesser strength, their low fertility, their "lack of ardour." Though transplanted Europeans might survive in North America, they would not flourish. So influential was this thinking among elites that Thomas Jefferson felt compelled to mount a detailed defense of the North American climate and its plant and animal species in his only book, *Notes on the State of Virginia*. For Jefferson, establishing the existence of the mammoth—a beast larger than any found in Europe—and defending both American livestock and the sexual prowess of Native Americans were crucial to predicting a healthy and fertile white population in America. His vision of a republican civilization ultimately depended on the natural environment's ability to support properly European bodies.[32] Like the mammoth, the native body was a "production" of nature and a testament to the New World's inherent virility.

Discussions of the North American climate's effect on both health and fertility would continue. However, by the nineteenth century whites had proven themselves capable of prospering in both New England and the South. Colonists' bodily fears had gradually been replaced by a sense of their physical fitness for the eastern regions of North America.[33] But at midcentury, as Americans embarked on the effort to colonize the western half of the continent, western climates remained something of a wild card for white settlers. The regions west of the Mississippi were unfamiliar and relatively untested. Much of the landscape of the West was treeless and arid, in contrast to the humid and well-forested lands of the East. The initial American settlement experience in the Mississippi Valley had not been encouraging for whites, who had sickened and died in large numbers. "It is to be suspected," wrote the English physician John McCulloch in 1829, "that no changes and no cultivation will ever bring it into a state of salubrity." Moreover, these regions were still filled with nonwhite populations. The different climate and environment in the

West were subjects of constant commentary, although contemporaries acknowledged their lack of information. "The arid climates of the interior and the cool Pacific coast have been occupied so recently, and so little observed, that is difficult to trace the climatological geography of disease there," wrote J. W. Blodgett in a massive work on the American climate.[34] While most American elites espoused confidence that white Americans would eventually populate western North America, the region's suitability for white bodies and Euro-American civilization was a subject of ongoing debate. Like their European counterparts, Americans feared that the environmental characteristics of new lands might frustrate their desire for expansion.

Consequently, knowledge of the relationship between climate and disease became as important as geologic or agricultural assessments to furthering the colonization of western North America, and the period saw several important American contributions to medical geography. In 1842 the army surgeon Samuel Forry used data collected by the military to compose the first complete medical geography of the United States. Forry emphasized the need to move from anecdotal accounts of climate and disease to the quantification of climatic features, and his work was widely lauded as an original and important contribution to medical science.[35] Like most American physicians, Forry drew heavily on Humboldt, whose mapping of isothermal lines had disrupted an older reliance on latitude alone as the principal factor determining climate. When latitude was considered in isolation, the more southerly location of North America relative to northern Europe was cause for concern. Humboldt's isothermal maps, on the other hand, helped to draw attention away from differences between the old and new worlds over which Jefferson and Buffon had argued. He reassuringly linked North America with Europe by redefining the United States as an unambiguously "temperate" region.

The publication of Daniel Drake's massive work, *A Systematic Treatise on the . . . Principal Diseases of the Interior of the Valley of North America as They Appear in the Caucasian, African, Indian, and Esquimaux Varieties of Its Population* (1850–54), drew international attention to the medical geography of North America. In many ways, Drake was an unlikely person to make such a contribution. He was raised on the Kentucky frontier at the turn of the century, far from the centers of medical knowledge. His medical training consisted of an apprenticeship with the most prominent of Cincinnati's four physicians. After establishing his own practice, Drake published a pamphlet describing the climate, topography, and diseases of his town. The work was well received, and that publishing success inspired him to undertake an exceedingly ambitious effort to chronicle the diseases of the entire West. Drake embraced as his region of study the area between the Allegheny Mountains in the east and the Rockies in the west and running from the Gulf of Mexico to the Polar Sea. He was explicitly Humboldtian in his approach, emphasizing the primary importance of latitude and altitude to disease and the local character of both symptoms and cures and insisting that the watershed was the proper unit of medical analysis. All told, Drake spent more than ten years collecting firsthand information and traveled more than thirty thousand miles. When published, his book ran to more than 1,800 pages. It immediately became a seminal publication in American medicine and inspired much more work along the same lines. That growing interest in medical geography also helped drive an interest in meteorology among American intellectuals, doctors in particular. In 1848 the newly formed Smithsonian Institution enlisted physicians across the country to assist in the systematic collection of national weather data. Lorin Blodget, a former employee of the Smithsonian, would publish much of that work in his 500-page *Climatology of the United States* (1857), which American physicians embraced as a critical reference.[36]



Nineteenth-century medical geography was an elite, scientific, and transnational discourse, but it emerged at a time when even scientific knowledge was acknowledged to be profoundly local. The goal of medical geographers was not to erase local particularity but to quantify and systematize it. Thus the most valuable work in the field could, and often did, emerge from the periphery—as in the case of Drake's *Systematic Treatise*. It was on the periphery where new and unusual relationships might be uncovered and where existing theories could be tested against new circumstances. Medical geography was a science, but it was a science of local experience.

## EVALUATING THE ENVIRONMENT OF CALIFORNIA

As Americans set their sights on colonizing the Pacific Coast, discussions of the far western environment and its effects on health appeared in a variety of places: newspaper articles, medical periodicals, emigrant guides, almanacs, personal letters, and government reports. The region of California generated no shortage of medicoenvironmental commentary, and among the most prolific writers were those who most enthusiastically and uncritically advocated settlement: western boosters.

Booster literature on California proliferated along with the push for American expansion in the 1840s. Despite the profusion of writers, the tracts themselves have a formulaic quality. Boosters routinely discussed those details that had some bearing on settlers' economic prospects: land availability, soil fertility, the length of the growing season, the size and character of towns, and the availability of transportation. These same writers also almost invariably addressed the region's effect on health.[37] And despite the devastating experience of illness in the 1830s, California boosters made much of the region's "salubrity" in the following decade. Perhaps this is not surprising. Like modern tabloids, booster literature is notoriously unreliable. History and environments alike can too easily be rewritten to further social and political goals, and booster accounts of California were motivated at least as much by desires for American colonization as by empirical observation. Those inspired to write about the region in the 1840s typically sought white settlement in the Far West, America's "manifest destiny," regardless of any potential costs in human suffering. And though what they wrote was not necessarily or even likely to be true, they tell us something about prevailing cultural vocabularies: what boosters wrote about presumably held some meaning for their intended readers. Thus while the repeated, almost obligatory, insistence on the region's healthfulness might say little about the actual prevalence of disease, it suggests that perceptions of health were important, even critical, to understanding a foreign place. Nineteenth-century boosters did not invent the connection between climate and health; they did, however, wield that connection freely, often with considerable flair.

Richard Henry Dana, one of the most widely read popularizers of California in the 1840s, claimed that the region was "blessed with a climate, than which there can be no better in the world; free from all manner of disease, whether epidemic or endemic." John Marsh, who settled in California in the 1830s and offered his services as a physician (although he, like many other physicians in this period, had no formal medical training), wrote, "It is much the most healthy country I have ever seen, or have any knowledge of. There is no disease whatever than can be attributed to the influence of the climate." Yet Marsh himself maintained a thriving medical practice, treating both Indians and whites for fever and ague and other diseases. The author of a popular emigrant guide published in the mid-1840s made a point of denying that the virulent "fevers" known to have killed thousands of Indians in the previous decade were attributable to any "local" causes but instead blamed the mortality on the habits of the Indians themselves. He went on to claim



that "there is no country in the known world, possessing so fertile a climate, of such mildness and uniform salubrity."[38] Victor Jean Fourgeaud, a physician with connections to the expansionist politicians Thomas Hart Benton and William Gilpin, went considerably further in his account of the region's effect on health. In a piece intended for eastern audiences and potential immigrants, Fourgeaud asserted that "the general salubrity of California has justly become a proverb. The surgeons of California have remarked that wounds heal here with astonishing rapidity, owing, it is supposed, in a great measure, to the extreme purity of the atmosphere." For those who sought American colonization of California, it was critical to establish the region's healthfulness, and among this set Fourgeaud's claim for the wound-healing properties of the atmosphere would be frequently repeated.[39]

What boosterism alone could not accomplish the discovery of gold did. In 1849 a massive migration to California began that decisively shifted the region's racial and ethnic demographics. Perhaps as many as 90,000 immigrants arrived in California in a single year, and between 1848 and 1860 the population rose by almost 300,000.[40] With so many people suddenly in the region under such extraordinary circumstances, accounts of the local environment proliferated. Those who traveled to California during the gold rush were not of one mind regarding the region's healthfulness, however. Individuals evaluated the environment's effects through both their personal experience and their hopes. Some, such as the physician John Baker who came to California from New Hampshire in 1853, managed to stay relatively healthy and attributed their vigor and success in part to the positive effects of the local climate. But many more wrote of illness and disease. Sickness seemingly surrounded and enveloped miners and travelers in the early 1850s. The journalist Bayard Taylor visited the interior of California in 1849 and claimed that "three-fourths of the people who settle in Sacramento City are visited by agues, diarrhoeas, and other reducing complaints." The experience of most miners confirmed this claim. As the miner George Kent confided to his journal, "Almost all of us had severe attacks of the diarrhoea or dysentery either before or after our arrival at this place." "Never had I been so ill before," wrote Thomas Kerr after he came down with "the ague" at Sacramento. Still another miner, John Gunnell, wrote, "[I] had not been in good health since I bin in Calaforn" and on that account advised others not to make the journey. "Gold was not a sufficient recompense," another physician and failed miner wrote, "for disease and broken constitution."[41]

From the early 1850s on, the incongruence of booster accounts and bodily experience was a common theme in California writings. "I am satisfied," wrote George Kent, "that the ideas we had formed of California before leaving home were very incorrect, and people who come out here must form their opinions of this new state independent of any home notions derived from Fremont, newspaper accounts &c." The writer Alonzo Delano repeatedly maligned the popular account of Edwin Bryant, in particular his claims about the salubrity of the climate and the purity of the atmosphere. Delano wrote, in contrast, "I never saw so much suffering and misery from disease in all my life as I have seen during a five months' residence in California." Immigrant doctors were particularly apt to attack the booster literature of the period for its inaccuracies. Jacob Stillman, a physician from New York, joined the rush to California in 1849 and subsequently wrote, "I was deceived in some respects; the healthfulness and beauty of the country was exaggerated by the early explorers." Dr. Thomas Muldrup Logan, a native of Charleston who arrived in San Francisco in 1850, wrote after four months in the state, "As to the health and climate of California, I now speak from experience when I affirm that we have all been grossly deceived. . . . [Since my arrival] I have not passed one perfectly well or pleasant day." In fact, Logan concluded a particularly gruesome depiction of the ravages of cholera in California with the ironic comment, "[This was] a land where I had been led to expect an Italian clime—an Archipelagian salubrity, and El Dorado harvest!"[42] The early reports of the California State Board of Health, first published in 1871, similarly undercut any consensus on the region's healthfulness; instead the authors went to considerable length to catalog the diseases associated with every region of California and condemned as injudicious the "extravagant" portrayals of the state's healthfulness promulgated by "non-professional travelers." As one leading California physician wrote, "The most erroneous statements have been circulated, either by travelers or by interested residents. It is our imperative duty as medical men to correct such error and to disseminate the truth."[43]

Such cautious and often negative assessments seemed to be borne out by the arrival of cholera in northern California in 1850, smallpox in 1852, and the rapid spread of dysentery and various "malarial fevers" in the ensuing decade—not to mention the high rates of insanity reported among recent immigrants to the state. Disease spread rapidly in the havoc of colonial invasion, though it is difficult if not impossible to assess the material prevalence of disease in contemporary scientific terms. The



only available statistics on death and disease from the period are fragmentary and unreliable by contemporary standards. Moreover, nineteenth-century categories of disease do not correspond neatly to contemporary ones. The most systematic accounts of disease from the period appear in army reports on the health of troops stationed in California; yet even these reveal more about the cultural gulf that separates the nineteenth from the twenty-first century than about disease as we might now understand it. What are we to make of the category "fevers," one of the most common causes of death in early California? The reports do contain death rates for the army, and by themselves these do not suggest that troop mortality was especially high in California—at least as compared with the southern United States or the tropical regions of the world. Yet disease in California was acknowledged to be highly localized. In some regions, rates of illness and death rivaled the most disease-ridden sections of the South. Army surgeons noted that the prevalence of illness, if not death, at certain posts was disturbingly high by any contemporary standard. Camp Far West, located in the Sacramento Valley, was abandoned in 1849 on account of its unhealthfulness, and a second fort, established some distance farther north, was similarly abandoned in 1856.[44] The city of Sacramento, a center of gold rush activity, was known to be especially sickly. Death rates calculated for the city in the 1850s are considerably worse than those for the state as a whole: 39 per 1,000 persons in 1851; 74 per 1,000 in 1852, when cholera was at its height; and 27 per 1,000 in 1855.[45]

Yet physicians routinely commented that death rates alone failed to tell the story of illness adequately. Many diseases were prevalent in early California, and the incidence of disease seemed to be increasing in some regions. Cholera appeared again in 1860, and smallpox struck the state three times in the first two decades of American occupation. Of equal or even greater concern were the various fevers. "Malarious" diseases reached epidemic proportions in central California in 1858, and some physicians regrettably acknowledged that this class of diseases was endemic to their new home. Fifteen years later, the State Board of Health noted with resignation that "throughout the whole of the State there must continue to be more or less of malaria for centuries to come, if not for all time." Aside from malaria, California physicians recorded the presence of scarlet fever, measles, diphtheria, influenza, typhoid, phthisis (consumption), and various forms of dysentery and intestinal disease. Insanity also elicited deep concern. California had a much higher proportion of supposedly insane individuals than other regions of the coun-

try, as high as one in every 490 persons. Insanity had been a local concern since the gold rush, but in the 1870s the State Board of Health noted somewhat anxiously that it might become an epidemic. Explanations focused on the "pace" of life in California, the heterogeneous social climate, and even "nostalgia," but most acknowledged that the local climate was at least partly responsible.[46]

Observers of California often pointed to bad habits and poor social conditions that were exacerbating disease, especially among the miners. Whereas the environment was a critical factor, the characteristics of an individual body were certainly relevant. Even in an unhealthy climate, not everyone succumbed to illness. Disease and death were the result of the "combined influence of the meteorological and physiological conditions modified by temperament."[47] Dr. J. P. Leonard of Rhode Island, who arrived in California in 1849, immediately wrote to the *Boston Medical and Surgical Journal,* noting the region's general healthfulness and downplaying the existing diseases. However, just four months later he was unable to maintain the same sanguine assessment. Writing to the same publication, he now acknowledged a "vast amount of sickness in San Francisco during the past summer," much of it fatal. He listed dysentery, diarrhea, pulmonary disorders, and fevers as the most prevalent diseases. Yet Leonard was reluctant to change his overall assessment of the California environment; instead he, like many others, called attention to the "intemperance, dissipation, disappointment, privations, exposure &c." that complicated recovery.[48]

How one understood disease causation had potentially enormous implications for the future of the region. Americans such as Leonard worried that the environmental characteristics of new lands might frustrate their desire for expansion, and mass outbreaks of disease were particularly disillusioning. While the British in India could resort to rotating new recruits into unhealthy districts, the American project of settlement depended on the ability of settlers' bodies to remain healthy, and reproduce themselves, in their new locations.[49] Only relatively healthy lands could be colonized through settlement in the long run. Thus to the extent that disease was the result of human action (intemperance, poor diet), the health of the community could be restored; accordingly, the prospects for settlement remained good. But to the extent that disease was the outcome of local environmental factors, it was largely outside human control; settlement, in turn, was threatened. By insisting on the role of "intemperance, dissipation, disappointment, privations, exposure &c.," Dr. Leonard and many others asserted somewhat hopefully the ability of immigrants to manage their own well-being in California.



The health concerns of nineteenth-century colonizers were inextricably connected to their obsession with race, and American immigrants to California were no exception. Although white immigrants spoke of health in general terms, the question that actually interested them was whether the region would foster the health of Euro-Americans, specifically those of northern European descent, the "Anglo-Saxon race."[50] The answer varied, but the intensity of the discussion indicates that both doctors and laypeople remained concerned about white racial health in the Far West. White settlers saw themselves as *more* vulnerable to certain diseases because of their race. Conversely, they believed that nonwhites, with the important exception of Native Americans, were less susceptible to the "tropical" diseases encountered in California, such as malarial fever. Writing of malaria, Thomas Logan paid particular attention to its differential effects among the races, noting "the insusceptibility of negroes and of those of mixed blood, born and bred in hot climates." He offered the tentative conclusion that "the susceptibility of the different races of mankind to malarial fevers appears to be in direct ratio to the whiteness of the skin." Others made frequent note of the seeming insusceptibility of Chinese immigrants: "The Chinese seem to be constituted something like the negro; they are not affected by the malaria as the Anglo-Saxons are."[51] Medicine and public health provided a scientific arena in which concepts of race and place were simultaneously constructed. And in an ethnically heterogeneous society such as post–gold rush California, vulnerability to specific diseases such as malaria could itself be a sign of whiteness. Illness could reaffirm one's race in the Far West, even while it raised questions about the suitability of the region for white settlement.

At the same moment, the growing crisis over slavery intensified both popular and medical interest in the debate over races and their proper places. Among Anglo-American intellectuals, racial categories hardened over the course of the 1840s and 1850s, and several leading British and American scientists argued the evidence for "polygenesis"—the belief that different human races had separate origins in different parts of the world and were thus biologically distinct. These ideas cast human migration—including American expansion—in threatening terms. In 1850 the Edinburgh anatomist Robert Knox published his treatise, *The Races of Men: A Philosophical Enquiry into the Influence of Race over the Destinies of Nations.* Knox, a former British army surgeon stationed at

the Cape of Africa, argued that migration from east to west was as dangerous as that from north to south; he held that Europeans in America and Australia had, in fact, degenerated. His outlook on the American future was equally dim: "A *real native* permanent American . . . race of pure Saxon blood, is a dream which can never be realized." The American physician and committed raciologist Josiah Nott concurred, writing that the races of the temperate zones had already "paid dearly for their migratory propensities." At the same moment, America's foremost scientist, Louis Agassiz, drew on Humboldt's geography to articulate his theory of zoological provinces and "natural racial zones." Agassiz argued that the various races of men could maintain and reproduce themselves only in distinct regions of the world.[52] In his view, human migration across these zones was doomed to failure.

For some, these debates over races and their proper places cast American westward migration in ambiguous if not completely negative terms. For Euro-Americans engaged in Western colonization, the concern with the health of white bodies took on particular urgency. In California, Euro-American perceptions of Mexican society only served to intensify the question of degeneration. In a passage quite typical of the period, Lansford Hastings, author of a popular emigrant guide, described the Mexican inhabitants of California as "scarcely a visible grade, in the scale of intelligence, above the barbarous tribes by whom they are surrounded." It was an open question whether the small population and what Hastings saw as the backwardness of Mexican California could be ascribed to the physical and moral inferiority of the inhabitants or whether the climate and landscape were in some way responsible. Common, as well as professional, knowledge held that the numbers and characteristics of the local people were important indicators of the quality of the land. As the Englishman James Martin had written in his medical treatise on the tropics, it was "an axiom of medical topography . . . that a slothful, squalid-looking population invariably characterizes an unhealthy country."[53] Euro-Americans were already convinced that the mild tropical climates of Latin America fostered degeneration and debility among their own kind, and accounts of American forty-niners frequently made anxious reference to the degenerate Europeans and Americans encountered in Panama and Mexico. As one prospective miner wrote of Chagres, the port of disembarkation in Panama, "Idleness and sloth meet you at every turn; you feel that you are in the midst of an inferior race of men, enervated by the climate, whom bountiful nature has made stolid and indolent." In contrast, harsh northern



European climates supposedly bred vigor. But what the relatively mild climate of California would yield was, in 1850, still unknown. Dr. John Baker expressed this mixture of hope and anxiety after he arrived in San Diego in 1853. "The people here were the first specimen of Yankeedom that we had seen since leaving New York," Baker declared, "or at least those who manifested in their appearance the healthy and active life which the Yankee is accustomed to do in our section of country. If we found a man from the States on the Isthmus [of Panama] (where there were many) they had the appearance of sickness and debility about them. But at San Diego they seemed to be healthy."[54]

Early white immigrants like Baker hoped that the environment of California would be more like Europe and eastern North America and less like South America, but that was merely a hope. In 1850, firsthand information about the region was still relatively scarce, and its vast distance from centers of civilization underscored its unknown character. Although the presence of gold made California irresistibly attractive, immigrants had almost no idea what to expect when they arrived. Moreover, in intellectual circles the rise of Humboldtian geography had cast California in an ambiguous light. Though North America existed securely within Humboldt's "temperate" zone, maps of average temperatures revealed local and regional anomalies. Much of California was anomalous in just this way; some localities stood out as exceedingly hot. In fact, at the time the nation's highest recorded temperatures came from Fort Miller in California's Central Valley. As Lorin Blodget noted in his *Climatology,* these summer temperatures "exceed those measures in [the] humid tropical climates," a fact that was not reassuring to prospective immigrants.[55]

California stood apart not only as a result of its summer temperatures but also because of its diverse society. Contemporary observers almost always commented on the state's racial and ethnic heterogeneity, and the need to attract more immigrants of "northern European stock" became a paramount concern of the state's American boosters. At the same time, however, Euro-Americans could not help but wonder whether there might be some underlying relationship between the social diversity that they feared and the regional climate. Many immigrant physicians viewed California as an experiment in racial health, and neither the social conditions nor the overall state of health in gold rush California initially inspired white confidence on this point. The editors of the *California Medical Gazette* noted in 1857 that recent immigrants to California were "peculiarly susceptible of disease," and the *Second Biennial Report* of

the State Board of Health acknowledged the popular sentiment that whites were degenerating in their new home and called for further scientific study.[56]

Among other things, concerns about degeneration prompted the close scrutiny of California's native inhabitants. Implicit in Jefferson's argument with Buffon had been the belief that Native Americans symbolized the quality of the land that whites now sought to colonize. Several decades later Euro-Americans still held Indian bodies as proxies for the natural environment. Whites understood Indian bodies as even more permeable than their own and thus as especially sensitive indicators of the region's healthfulness. As the doctor Frederick Hatch remarked in an early account of California, Indians were "by birth and hereditary impress . . . the peculiar subjects of the climatic influence and serve . . . to illustrate its features." Hatch, much like Thomas Jefferson before him, tried to read Indian bodies as healthy and resistant to disease. Similarly, John Griffin, an army surgeon in California during the war with Mexico, wrote that the Indians in southern California were "fine large, healthy looking fellows—and speak well for the salubrity of the climate." In the 1890s, when California health boosterism was at it height, Dr. Peter Remondino would extol the appearance, longevity, and endurance of the southern California Indians, comparing them to that paragon of physical and moral perfection, the ancient Greeks.[57]

Yet in the early decades of settlement, whites were also anxious to confirm their own biological superiority and their physical, as well as moral, fitness for the land they were appropriating. Indians presented something of a conundrum in this regard. It was necessary to understand Indians as both physically superior and physically inferior. The answer that many would settle on was to assert, as Dr. Logan put it, the remarkable "viability of the native Indian race . . . so long as he is not subject to the habits of civilized life." Native Californians were healthy and long-lived, but they were also ill adapted to progress and civilization. From this perspective, Native Americans were robust indicators of California's natural environment even while they were doomed to extinction.[58]

White women's bodies, like those of Indians, were understood as relatively more permeable than those of white men. Thus women were the most sensitive indicators of the environment's effect on white immigrants. Moreover, avoiding racial degeneration depended on the ability of female immigrants to produce able-bodied and unambiguously white children. Manifest destiny hinged not only on conquest and migration but also on reproduction. The success of colonial settlement hinged on



the ability of whites to outproduce indigenous peoples. Reproduction, in turn, depended on female health. Consequently, the diseases of women drew particular attention because of their potential effects on fertility and childbearing. Though opinions on women's health in California were mixed in the mid-nineteenth century, writers were more likely to declare their anxiety than to express optimism. In a description of California's diseases written in 1852, Dr. James Blake asserted that "there can be no doubt that the climate is conducive to fertility in the female." Yet in that same year the army surgeon at Monterey remarked that the "diseases peculiar to women" were more common than any other malady in that region. James Hittel, in an otherwise promotional account, admitted that women's diseases were common in the state, that fertility was low, and that women began to "wither" at the age of twenty-five. In the late 1850s the state's newly formed medical society splintered over a paper on women's health in California prepared by one of its members. Dr. Beverly Cole had written of the moral and physical degeneration of white women in the state, claiming that "in no place of civilization do the causes [of ill health among women] exist or prevail to the same extent as in California." Several members of the society walked out in protest, claiming that Cole, by his references to immorality, had disgraced California's white women and, not incidentally, had impugned the suitability of the California environment for white immigrants. In response to Cole's paper, a medical colleague argued that children born in the state to immigrant women were remarkably healthy and would constitute "a highly improved variety of the human species."[59]

Despite the harsh reaction to Cole's paper, the debate over women's health in California continued for the next three decades. In its first report the State Board of Health corroborated the popular perception that "females [were] more susceptible to all kinds of disease, especially in California," and a book titled *Female Health and Hygiene on the Pacific Coast,* published in 1876, began by referring to the "unusual prevalence of disorders affecting the reproductive organs among ladies on the Pacific Coast." Others, doctors and boosters alike, continued to argue to the contrary that the local climate fostered both female fertility and healthy children. Dr. Thomas Logan appealed to mortality statistics to demonstrate that the proportionate mortality of women in California was lower than that of men. Charles Nordhoff, in his popular booster tract written at the behest of the Southern Pacific Railroad in 1874, included the obligatory reference to the attractive forms of women and children: "The climate is most kindly to little children, which is perhaps one its best tests.

One cannot travel anywhere in California without noticing that the forms of the women who have lived some years here are more full and robust than [in the East]; while the children are universally chubby and red-cheeked." But the attention devoted to the issue only underscored the anxieties of early white immigrants.[60] The ways in which the California environment might alter their bodies—and those of their children—was, at best, an open question.

Over time, as white dominance became an established reality in the region, California promoters such as Nordhoff, as well as some of the more boosterish doctors, would turn concerns about degeneration around and claim that the mild climate of the Pacific Coast produced an even healthier breed of white Americans. Already in 1869 the author of a popular tract on California, Charles Loring Brace, had acknowledged the effect of climate on the human "type," but he also assured his readers that the result was a sturdier and more attractive breed of Anglo-Saxons: "One sees great numbers of fine manly profiles, with full, ruddy cheeks, and tall, vigorous forms." However, Brace still felt the need to reassure his readers that while climate could improve health and vitality, it could not alter race. As he put it, "Blood is stronger than isothermal lines." But even these remaining reservations about racial malleability would soon disappear. Dr. Peter Remondino, who became one of the foremost boosters of southern California (as well as the owner of a popular health resort in San Diego), would pen several articles on climate and health in the 1880s in which he refuted the widely held idea that humidity was bad for health and only harsh climates bred vigor. Instead, as Remondino put it, California's "moist marine air and equable temperatures produce the most perfect specimens of physical development."[61]

## COLONIAL MEDICINE AS ENVIRONMENTAL SCIENCE

Nineteenth-century immigrant doctors were among those who wrote most prolifically about the environment of California. In contrast, contemporary medicine is not much concerned with the landscape; physicians generally confine themselves to the terrain of the human body, while the natural environment is left to a host of other disciplines. This narrowing of professional perspective and the intellectual parsing of environmental and medical sciences is largely a product of the early twentieth century. Nineteenth-century understandings of health required physicians to pay close attention not only to the sufferer's body but also



to the surrounding landscape. It was only logical that among the early European exploring expeditions, the same person typically served as both doctor and naturalist.[62] And that the issue of health and environment drew the sustained attention of professionals as well as laypersons should caution against reading the large popular literature on the subject as merely the invention of boosters or the writings of medical eccentrics. Rather, nineteenth-century science underwrote and sustained widely held beliefs that melded human health and the natural environment into an inextricable whole. Even while popular and professional writings diverged in their particulars, they reinforced a view of the body as an entity that was both porous and environmentally sensitive.

But for professional medical men who saw themselves as serious scientists, the relationship between health and environment remained frustratingly vague and qualitative. In the national and even transnational intellectual debates over health and environment, several early California physicians saw themselves at the forefront of an empirical effort to answer questions about climate, environment, and racial fitness in a more definitive way. As the reception of Daniel Drake's treatise on the Mississippi Valley attests, professional interest in scientific medical topography was high in the 1850s. Consequently, at the moment of its colonization California formed a rich field for the extension of medicoenvironmental studies, and colonial physicians worked hard to institutionalize and scientize the study of the local environment. Several gold rush–era physicians brought environmental interests with them to California, quite conscious of the fact that they were encountering a new environment to which bodies might react in unforeseen ways. Immediately on their arrival, several physicians committed themselves to the close study of the local environment in their adopted home and to the "patient and laborious accumulation of exact statistics."[63] From the outset, professional medicine in California had a strong environmental cast.

In many ways, the critical figure in early California medicine was Thomas Logan, a devotee of Humboldt who arrived in San Francisco with an established interest in climatology and the environmental basis of disease. Logan was born into a family of physicians in Charleston, South Carolina, in 1808 and was educated at the Medical College of South Carolina in a period in which probably less than half of all physicians actually took a medical degree. He supplemented his formal training with a tour to Europe and wide reading in his field, and he subsequently practiced in Charleston and New Orleans. But the mid-nineteenth century was a difficult time to be a doctor, and there is no

Figure 2. Portrait of Dr. Thomas Muldrup Logan, one of the most prominent and prolific American physicians in nineteenth-century California. Courtesy of the California History Room, California State Library.

evidence that Logan ever established a profitable private practice in the South. In 1850 he left Louisiana and the South for good. He joined the gold-inspired migration to San Francisco and quickly settled in Sacramento where he would practice medicine for the next twenty-five years. Having brought along meteorological instruments on loan from the Smithsonian Institution, Logan immediately commenced recording weather statistics. Eventually he would become one of California's most prominent physicians, a professor at the University of California, and president of the American Medical Association. As a leading figure in the California Medical Society and later as the first secretary of the State Board of Health, Logan lobbied strenuously for more meteorological study, arguing that "every city, village, and settlement should have its meteorologic record."[64]

Logan was joined by several other physicians who shared his professional interests and environmental orientation. Henry Gibbons immigrated to California in 1850, arriving from Philadelphia where he had been a faculty member at the University of Pennsylvania. In San



Francisco, Gibbons supplemented his medical practice with the study of native plants and of meteorology. As the editor of the leading California medical journal, he urged every physician to "train himself as an observer of meteorological phenomena. The thermometer, the hygrometer, the currents of wind and cloud, should be as familiar to him as the stethoscope, the microscope and the speculum." Frederick Hatch, a graduate of New York University's medical school and a successful physician in Wisconsin, immigrated to Sacramento in 1853. Hatch would become a close observer of the California environment and would write several papers on the subject; and, like Logan, he would serve as a meteorologic correspondent for the Smithsonian. His observations on climate and health in his adopted state were included in Blodget's 1857 *Climatology*. Hans Herman Behr, an immigrant from Germany, had trained in medicine at the University of Berlin, where he had been a student of Humboldt and another well-known German geographer, Karl Ritter. In California, Behr combined his interests in climate and health with the close study of native plants and insects.[65]

These and other individuals would succeed in institutionalizing the study of environmental medicine at an early date. In a speech before the newly formed California Medical Society in 1856, Logan insisted that a key aspect of the organization's mission was "to work out the problem of climatic influence on the physical condition of man—to investigate the nature and causes of endemics and epidemics—to show how far man's agency has to do in the matter." At the second meeting of the society, Logan was instrumental in establishing the Committee on Medical Topography, Meteorology, and Endemics and Epidemics. The following year, he chaired the committee and wrote a lengthy report on the subject. When the California State Board of Health was founded in 1871, Henry Gibbons served as its first president and Logan as the first permanent secretary. Under their leadership that organization would make the study of the physical environment and its relationship to health a priority, and medical topographic studies would proliferate in California for two more decades.[66]

This emphasis on the environmental causes of disease may well reflect the fact that until the last decades of the nineteenth century California remained very much a settler society, and settler anxieties about relocation made western physicians especially attentive to their surroundings. Given that nineteenth-century bodies were permeable, new and diverse environments required both wide and meticulous scrutiny. While indigenous bodies were powerful indicators of the land, immigrant bodies

required careful monitoring and care in a new place. Doctors such as Logan and Gibbons saw their studies of environment and health as indispensable to securing the successful colonization of California by white Americans. However, since it was not yet clear what aspects of the environment were critical to health, Logan advised his colleagues to collect as much data as possible—not only temperature and altitude but also dew point, quantity of clouds, timing of frosts, depth of ground frozen, temperature of wells and springs, timing of animal migrations and fish runs, presence of ozone in air, and causal phenomena such as thunderstorms, tornadoes, hailstorms, the aurora borealis, meteors, shooting stars, and earthquakes.[67] Discourses on medicine and health were thus not only discussions of the human body but also important realms of environmental understanding.

The approach of nineteenth-century immigrants to questions of health and disease reveals a world in which the very concept of agency was understood in nuanced ways. Disease was not simply contained within certain pathogens. Discussions of causality, whether carried on by physicians or laypeople, embraced theories of environment and contagion, individual constitution and moral rectitude, personal habits and social progress. In this world, the local environment was sometimes healthful and sometimes threatening—but it was always active, contingent, and relevant to the bodies that resided there. Agency, moreover, was not necessarily confined to human beings, nor were the causes of disease discretely located in certain microorganisms, at least not yet. Rather, disease was only the most obvious sign that humans were part and parcel of a larger whole, a world that, though not completely opaque to scientific methods, often responded in unpredictable ways. Certainly American immigrants who came to California in the mid-nineteenth century did not doubt the virtues of white settlement. But when Logan wrote of the need to study "the modifications diseases may undergo from the agency of causes of a local or special character," he, like many others, acknowledged at the outset that the history of that project would be the outcome of nonhuman as well as human forces.

# 2

# Placing Health and Disease

> There can be no question . . . that the extent of territory, and variety of climate and soil, within the limits of the State, render it a peculiarly favorable one for gaining valuable and comprehensive knowledge of the influence of various conditions upon the rate and causes of mortality. There is an opportunity to compare, in degrees of latitude; sea levels with elevations of eight thousand to ten thousand feet; and, what affords an unusual contrast, seacoast valleys chilled by an Arctic current, with vast interiour prairies of almost tropical temperature. Doubtless, when sufficient time shall have been given to the study of these conditions . . . the result will be a demonstration of important relations between them.
>
> *Second Biennial Report of the California State Board of Health*, 1873

Understandings of environment and health in the nineteenth century were shaped by broad cultural and political currents—European medical geography, debates between contagionists and anticontagionists, transatlantic racial theories, American expansionism, the political crisis over slavery. But they were also shaped by the physical experience of individuals and the material realities encountered in specific places. Laypersons and physicians alike believed that both disease and cure could be understood only in their specific contexts. Diseases were often unique to their localities, and a treatment that worked in one place could all too often fail in another.

Although considerable emphasis has been placed on the supposed triumph of germ theory in the last third of the century, the theory took hold quite slowly among professionals as well as nonprofessionals. In brief, germ theory held that disease could be traced to singular and discrete etiologic agents that penetrated the body rather than to the much vaguer and more nuanced concept of imbalance. However, nineteenth-century

# 5

# Contesting the Space of Disease

[We are] trying to answer the question, yes or no, is this a safe place to live?

Dr. Richard Whitfield of the Kern County Health Department, testifying before the California Senate Committee on Toxics and Public Safety, 1985

Communities expect epidemiologists to be able to reach some conclusion about exposure and disease, but the constraints of available information can make it difficult to distinguish between competing hypotheses of major economic and public health consequence.

Peggy Reynolds et al., "The Four County Study of Childhood Cancer: Clusters in Context," 1996

The science of epidemiology needs a real kick in the rear end.

Connie Rosales, mother of cancer sufferer, 1988

By the early 1970s the ecological challenge of Rachel Carson and the United Farm Workers had been met by a reassertion of existing public health strategies. Even as the concept of environmental quarantine was being promulgated, however, the problem of a toxic landscape was exceeding its solution. Chemicals were not stationary, and property lines and the posting of metal signs did not stop pesticides from moving into soil, water, air, and human bodies. In 1979 the discovery of a highly toxic pesticide in the Central Valley's groundwater raised new fears about the regional landscape. Further monitoring would soon reveal that the valley environment was far more contaminated than previously suspected and that chemicals could move farther and persist longer than





anyone had predicted. What was once thought to be relatively contained was found to be diffuse. Over the course of the 1980s, it became obvious that pesticides were not confined to farmers' fields. Consequently, groundwater contamination, and then toxic air pollution, would become a focus of the state's health and environmental agencies and an ongoing concern of valley residents.

During this period, residents of McFarland, a small town in the southern half of the valley, realized that a startling number of children in their community had been diagnosed with various forms of cancer. When they began to suspect that their contaminated environment was the source of their children's illnesses, McFarland, an otherwise unremarkable place, became one critical site for rethinking how health might or might not be related to the environment in the late twentieth century. Many people, both within and outside the valley, immediately connected the health problems in McFarland—"the West's best-known cancer cluster"—to the region's history of chemical pollution. For them, McFarland's plight symbolized the devastating and unavoidable effects of the modern agricultural environment on human health. At the same time, it pointed to the unfulfilled and illusory promises of sanitary modernity.[1]

McFarland was but one of many localities in which chemicals and illness coincided and where modern understandings of health and disease would be publicly challenged. The 1980s were the toxic decade, in the Central Valley and beyond. Ushered in by the disasters of Love Canal and Three Mile Island, the decade saw hundreds of American communities struggle with environmental contamination and its implications for public health. Stories about hazardous waste and groundwater pollution—and their possible health effects—were the staple of daily newspapers, the subject of television specials, the focus of congressional hearings, and at issue in thousands of lawsuits nationwide. Contemporary films and novels articulated the pervasive toxic fears and their often ambiguous sources. Terms such as *PCBs* and *dioxin* entered the national lexicon, and fears about the environmental causes of birth defects and cancer drove many self-described homemakers to become environmental activists.[2]

In California, officials found themselves caught up in a series of environmental and public health controversies that they could not contain. Since the early twentieth century, public health experts had claimed authority based on their ability to isolate the causes of disease and to block their entry into human bodies. But in the case of McFarland, experts could neither explain nor control the migration of chemicals into

air, water, and food. After years of investigation, California's health officials would insist that the McFarland environment was "safe," yet their findings would fail to allay the concerns of most local residents. Instead residents now openly questioned the methods and assumptions of public health and refused to accept expert assurances that the local environment was irrelevant to disease. Whatever view one might ultimately take of its cause, the McFarland cancer cluster and the ensuing controversy revealed that modernist ideas of place and health in the Central Valley were no longer widely shared, and perhaps never had been.

## UNCOVERING POLLUTION IN THE POSTWAR DECADES

Unlike the changes wrought by large dams, the environmental effects of chemicals are often subtle. At least initially, many of the changes chemicals induce occur at a level far below that of human experience. The poisoning of farmworkers had made chemical effects visible. But the resulting environmental focus remained relatively narrow: the concern lay with exposure to either the sprays themselves or sprayed crops. Regulators did little to assess the presence of chemicals in the broader environment; they assumed that the ongoing use of chemicals had no relevance to most people's health.

Despite official disinterest, accumulating evidence suggested that pesticides were widely distributed in the environment. The first sign that agricultural chemicals were entering the Central Valley's water supplies had emerged in the 1950s, even before Carson had begun writing *Silent Spring*. Then in the early 1960s several fish kills in the San Joaquin River made it clear that agricultural practices were affecting water quality. In 1963 water engineers finally tested agricultural runoff in the Central Valley for salts, fertilizer products, and various pesticides and herbicides; they found them all but were quick to dismiss their significance. The following year, residents of the San Francisco Bay area became aware of a proposal to build an immense drain that would siphon agricultural runoff from the valley and deposit it in San Francisco Bay. This was yet one more component of the massive reengineering of the valley's waterscape that had been under way since the late 1930s. A coalition of local interests subsequently delayed construction of the so-called master drain and forced the U.S. Public Health Service to assess the health and environmental effects of the project on downstream waters. When it finally appeared in 1967, that study identified thirty-five pesticides in the Central Valley's agricultural drain water.[3]



Studies of chemical contamination in water supplies were the exception however. Through the end of the 1960s, the only monitoring done by most public drinking water suppliers was a test for bacteriological contaminants. Only in the early 1970s did the problem of chemicals in drinking water receive any regulatory attention. In 1972, while Congress was debating new drinking water legislation, the Environmental Protection Agency (EPA) announced that tests of the New Orleans water supply had revealed the presence of thirty-six organic chemicals, including three known and several suspected carcinogens. Two years later the Environmental Defense Fund (EDF) issued a widely publicized study showing that people in the New Orleans area who relied on surface water had higher cancer rates than those who relied on groundwater. The implication that EDF and others drew was that chemically contaminated surface water was raising cancer rates. These developments helped ensure passage of the Safe Drinking Water Act later that year. Among other things, this legislation directed the EPA to ascertain the scope of organic chemical pollution and to set water quality standards for any chemicals that posed health risks.[4]

The idea of water quality standards was not new in 1974. Sixty years earlier, as Hibbert Winslow Hill was pronouncing the irrelevance of the environment to health, the U.S. Public Health Service had adopted the first drinking water standards, a maximum allowable level of the bacteria *E. coli* that was intended to control the spread of typhoid in interstate commerce.[5] These standards recognized the relationship between the environment and health, but, true to the precepts of germ theory, they cast that relationship in narrow terms. Disease was believed to be contained in the specific bacteria, and the water supply was assumed to be the principal route of exposure. Although the consumption of water and food opened bodies up to environmental influences, bodies were otherwise envisioned as impermeable.

Regulators are seldom innovators. They typically build on the structures and protocols that are already in place. Thus, the federal regulations enacted in the wake of the Safe Drinking Water Act extended the approach forged in the early twentieth century. The relationship between water supplies and health was encapsulated in a set of numbers, the "maximum contaminant levels," or MCLs. Like the threshold limit values adopted by occupational health researchers and the residue tolerances adopted for pesticide-treated food, MCLs assumed that there was a level of exposure below which no adverse health effects would occur in any place, at any time. Moreover, the adoption of national standards

assumed at the outset that local environmental conditions and individual differences were unimportant. So long as concentrations of certain chemicals remained below their MCLs, chemical contamination was officially deemed irrelevant to anyone's health.[6]

More than a decade after *Silent Spring*, amid growing recognition of the pervasiveness of chemical contamination and the complexity of local ecologies, regulatory strategies still relied on a modern concept of the body. Maximum contaminant levels assumed single etiologic agents, clearly defined pathways of exposure, and an external environment that could be effectively controlled and managed. In fact, none of these was true. The relationship between organic chemicals in water and chronic disease (such as cancer) defied any easy etiologic description. The existence of these contaminants in multiple places—not only in water but also in air, soil, and food—defied any attempt to isolate pathways of exposure. And the inherent complexities of the environment defied attempts at monitoring as well as management.

Moreover, the reliance on MCLs assumed that all the relevant contaminants were known and could be identified in the laboratory; yet analytic techniques did not exist for most of the organic chemicals already in use. And even where reliable techniques did exist, they were often prohibitively expensive to employ. Making MCLs even more impracticable was the fact that little data existed on the toxicology or health effects of most chemicals on which to base a standard. When the EPA finalized its drinking water regulations in 1978, it adopted an MCL for just one category of organic chemicals. Pesticides were completely ignored.[7]

Experts were at least debating the health significance of pesticides in surface water at this time, but few expressed concern that these chemicals might also contaminate underground water supplies. Though aware of the potential for chemicals to move into groundwater but lacking dramatic evidence comparable to fish kills, most experts assumed somewhat wishfully that chemicals placed in the ground stayed put. Studies that addressed the fate of pesticides in soil and water were comparatively few; scientists and farmers alike assumed that the overlying soils protected groundwater from chemical contamination, acting as a kind of natural filter. Despite the extraordinary amount of pesticides used in the San Joaquin Valley, the region's groundwater was assumed to be relatively invulnerable to contamination—because its flat topography and dry climate generated little runoff. Consequently, groundwater supplies were rarely monitored. The state of California conducted just one

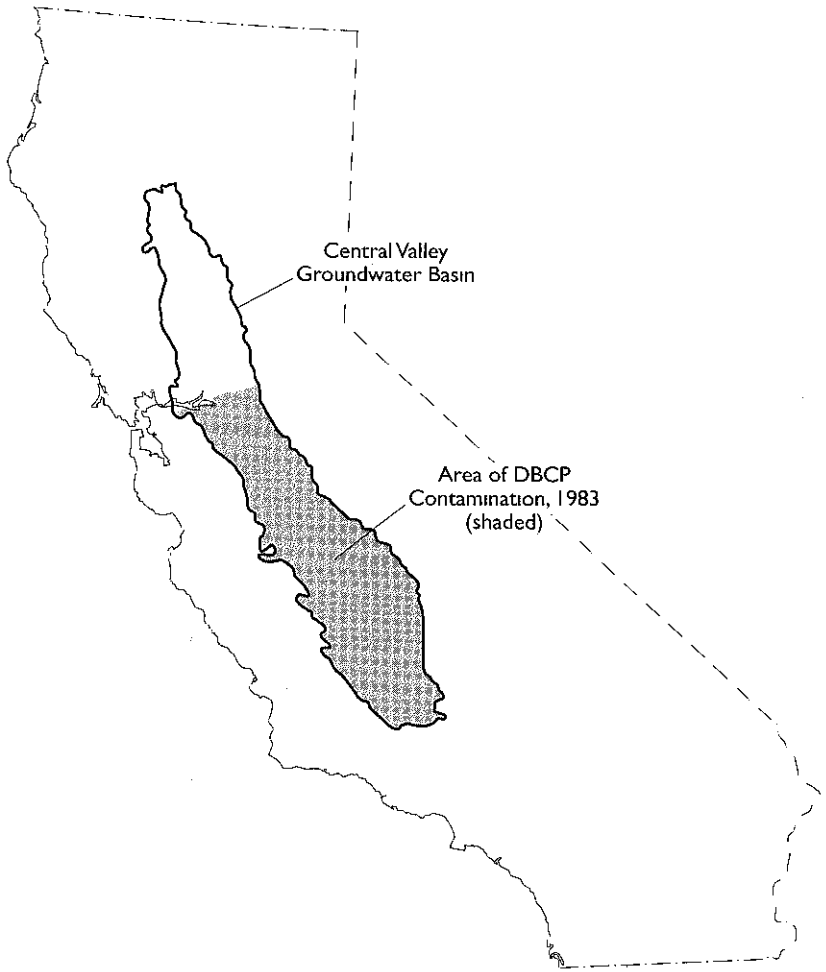


inquiry on the issue before 1970. In a study remarkable only for its poor design, investigators applied two pesticides (DDT and lindane) to a small test field and hastily concluded that agricultural chemicals typically degraded in place.[8]

It would take another decade, and the discovery of widespread groundwater pollution, to reveal the pervasiveness of chemicals in the valley's environment. In 1979 the California Water Quality Control Board tested some wells at the Occidental Chemical plant, located in the northern San Joaquin Valley town of Lathrop. They found excessive concentrations of 1,2-dibromo-3-choloropropane (DBCP), a compound handled at the plant and used by farmers to protect the roots of crops from small worms. DBCP had emerged as a chemical of major public health concern two years earlier, when male workers at the Occidental plant learned that it had made them sterile. DBCP's ability to cause reproductive and other abnormalities in laboratory rats had been known to chemical companies since the late 1950s; the first published accounts of its toxicity had appeared in 1961. Yet no restrictions were placed on its use. It was only when workers began to ask questions, and to link the deficiencies of their own bodies to the pesticides they handled, that the existing scientific literature was rediscovered. Within two months of that discovery, the EPA suspended the use of DBCP on nineteen food crops. Two years later both the state of California and the EPA suspended DBCP's registration.[9]

When water quality officials discovered DBCP in groundwater, they realized that the chemical was capable of moving out of the soil and into the water below. Although this was a disturbing and unexpected discovery, everyone involved still assumed the problem was localized. However, two months later regulators found DBCP in two wells in a nearby county. The state legislature then directed the California Department of Food and Agriculture (CDFA) to test groundwater throughout the valley. Those tests revealed that 90 out of 262 wells tested contained DBCP in measurable amounts. The water supplies of several valley communities were seriously contaminated.[10]

Given the region's dependence on groundwater and DBCP's extremely high toxicity, the scope of the potential problem was enormous. DBCP had been applied in high quantities on thousands of acres throughout the region for more than two decades. Almost simultaneously, environmental officials in New York discovered the insecticide aldicarb in wells on Long Island. Like DBCP, aldicarb had been used heavily in regional agriculture and had been thought to pose little environmental risk. Yet both




Map 2. The extent of DBCP contamination of groundwater in the Central Valley as of 1983. Redrawn from U.S. Geological Survey, *Ground Water Atlas of the United States*, vol. 1, *California, Nevada* (Reston, VA: USGS, 1995).

of these compounds were highly toxic and known to cause cancer in laboratory animals. Their presence in groundwater prompted the closing of scores of wells and indicated that the regular use of pesticides in agriculture, not just their disposal, might be polluting large quantities of the country's drinking water supply.[11]

The DBCP and aldicarb discoveries were but two of hundreds of cases of groundwater contamination that were uncovered in the late 1970s and



early 1980s. As more and more chemicals were found in groundwater in more and more places, toxic contamination emerged as a nationwide problem. In 1978 Love Canal, a working-class suburb in upstate New York, became a front-page news story. Residents had found chemicals oozing into their basements, and they pointed ominously to apparently high rates of illness and miscarriage in their community. In 1980 Congress held hearings on the scope and implications of groundwater contamination nationwide, while the plight of Love Canal residents prompted the first "Superfund" legislation to facilitate the federal cleanup of hazardous waste sites.[12]

In California the DBCP discovery starkly revealed the inadequacy of existing water quality regulations, which barely addressed groundwater and ignored many dangerous compounds then in widespread use. It also quickly drew the attention of state political leaders, who immediately called for more monitoring. More monitoring identified more contamination. In 1983 California investigators found another carcinogenic soil fumigant, ethylene dibromide (EDB), in valley groundwater—also at disturbingly high levels. Aldicarb was also found in many locations. The following year the state legislature passed a bill that, for the first time, required community drinking water suppliers to periodically test their water for the presence of common pesticides. By April 1985, 57 pesticides had been found in nearly three thousand wells across twenty-eight counties—most of which were in the Central Valley. Though California appeared to have the most widespread groundwater contamination, the problem was national and even transnational. Wherever pesticides were manufactured, used, or disposed of, some were likely to turn up in groundwater. As one EPA official put it, "The more we look, the more we find." By 1985, even with only limited attempts at monitoring, the EPA had found 17 pesticides in the groundwater of twenty-three states. Ten years later, more than 140 pesticides had been found in forty-three states.[13]

Not only had existing regulations overlooked the presence of organic chemicals, they had also failed to account for the complexity of the broader environment. Groundwater had been ignored in existing water quality standards in part because it was assumed to be relatively invulnerable. But, in fact, the susceptibility of groundwater varies tremendously. The fate of DBCP in one environment may be quite different from its fate in another. The likelihood of pesticides moving into groundwater, like the potential for pesticide-induced illness in farmworkers, was contingent on local environmental factors: the amount of rainfall and

agricultural runoff, the ability of particular types of soil to absorb water, the geologic conditions of the aquifer. Once again, there were countless local variables to be measured.[14] The only way to know what was happening was to return to the "field," to the specific ecologies in which all these chemicals had been used.

Environmental conditions in the Central Valley are difficult to understand much less to control. Contamination and toxicity remain spatialized in complex ways. One region of the valley differs from another. Field research would eventually reveal that the aquifer underlying the eastern side of the San Joaquin Valley was extremely vulnerable to pesticide contamination (a conclusion reached twenty years after a similar set of experts had concluded just the opposite). In part, that vulnerability lay in the soil. Most of the sediments in the eastern half of valley had eroded from the Sierra Nevada. As the mountains weathered, sand and rocks settled at their base. Consequently, the soil in this area is derived from granite; the grains are coarse, and water moves through the intervening spaces with relative ease. Moreover, groundwater in the area is often shallow, from twenty to two hundred feet below the surface. Whenever water enters the ground, it is likely to pull substances out of the soil and carry them down to the underlying aquifer. This means that when pesticides are applied to crops, they can move quickly and easily into the water below. In contrast, environmental conditions in the western half of the valley make groundwater contamination less likely. There the soil comes from the Coast Ranges. The sediments are finer and are more likely to attract and attach chemicals. Even though groundwater is shallow, it is more difficult for organic chemicals to travel downward, and once in the groundwater they move more slowly. Although contamination has been found throughout the region's aquifers, wells on the east, and most populated, side of the valley are far more likely to be polluted and to have substantially higher pollutant concentrations.[15]

Predicting the fate of chemicals in the valley environment was made more difficult by the region's history. Humans have exploited and altered these aquifers in significant ways. Although groundwater was first used in the San Joaquin Valley in the 1880s, pumping rates increased dramatically after World War II. It was the accessibility of groundwater that allowed for the rapid intensification of agriculture in such an arid climate in both the pre- and postwar decades. The increased reliance on well irrigation meant that in any year large quantities of water moved up through the wells. Groundwater was replenished not from the flow of streams (most of which were completely diverted for agricultural purposes) but from the excess irrigation water that soaked into the soil; and that water was likely to carry significant quantities of chemicals and nutrients. Pumping has even altered the direction of groundwater flow in the area. Water that used to flow generally east, toward the trough of the valley, now flows west, toward some of the most powerful pumps. Water that once flowed toward the soil surface now flows downward. Even deep groundwater, which is typically protected somewhat by overlying soils, has been affected. Thousands of wells now tap the deeper aquifers; more are drilled whenever there is a drought. Often poorly constructed by cash-strapped farmers, irrigation wells have cut through natural barriers of soil and clay and have become conduits for contamination. Inside a well, the polluted groundwater in a shallow aquifer mixes with the uncontaminated water from below. Like the farms above, the underground hydrology is a complex product of nature and human history. Consequently, regional groundwater is now more easily and more thoroughly contaminated. Groundwater hydrology in the region is also more complicated and variable than it would otherwise be. Where a pollutant ends up depends not only on the geologic characteristics of the aquifer but also on which combination of wells is being used at different times.[16]



The discovery of pesticides in groundwater and the difficulties it presented undercut the assumption that the relationship between environment and health was one that could be managed. Certainly humans had applied the chemicals, but they had never intended, or even considered, that years later those chemicals would turn up in local drinking water. Once widespread contamination was discovered, however, agencies and politicians were anxious to demonstrate that they were in fact protecting public health. Caught in a defensive posture, they turned to familiar strategies. Immediately after the DBCP revelations, both the state and federal governments quickly issued an MCL for DBCP in drinking water.[17]

Chemicals moved through the valley's air as well as its water, but air is even more difficult to test and regulate. Although researchers and community members had been concerned with pesticide "drift" since the mid-1940s, significant research on airborne toxics would not come for another forty years. Even in the late twentieth century, it remained difficult to assess air quality in a quantitative fashion. However, field tests revealed that as much as 90 percent of an applied pesticide could volatilize from the surface of soils and plants within a matter of days. Valley residents already knew through experience that ambient air could harbor pesticides; this had been the basis of complaints that dated back

to the early 1950s, and such concerns had not abated. Although the CDFA did not publicly track or report the number of illnesses caused by airborne pesticides, it acknowledged more than one hundred illnesses resulting from "coincidental exposures" in 1986 alone. In one of several incidents in the 1980s, residents of the town of Ceres were evacuated after an atmospheric inversion trapped airborne pesticides (methyl bromide and chloropicrin, a component of tear gas) and generated toxic smog. People living up to two miles from the target field became ill.[18]

Again the natural conditions of the valley exacerbated the problem. Researchers were surprised to find that the valley's dense tule fog could both transport pesticides over long distances and significantly concentrate them. Sampling revealed that wintertime fog routinely contained organophosphorus compounds (e.g., parathion) that were sprayed on fruit trees during the colder months. The measured concentrations were extremely high—in some cases, several thousand times higher than what would be expected in rainwater. Not only were the pesticides present in fog, but so were their highly toxic degradation products (oxons). Moreover, contaminated fog likely poses a substantially greater health threat than does polluted air, because the inhaled particles are not quickly exhaled but linger inside the lungs. For some, the discovery of pesticide-laden fog might have recalled the much earlier concern with miasma. Once again, the valley's climate and environment threatened health—only this miasma had taken on a modern, chemical form.[19]

California officials adopted legislation to address toxic air contaminants in 1984, and their approach was the same as it had been for drinking water: the state would rely on animal toxicity studies to develop maximum allowable contaminant levels for specific chemicals. The responsibility for adopting air quality standards, however, was given to the CDFA—an agency that had shown little enthusiasm for regulating or monitoring pesticides in the past. Fifteen years after the Toxic Air Contaminants Act, the CDFA had adopted an air quality standard for just one pesticide.[20]

While no one was watching, pesticides had moved into air, soil, streams, and groundwater, and also into human and animal bodies.[21] Although the monitoring of pesticides in water and air only began in the 1980s, there was no reason to think that similar conditions had not existed for at least the past three decades. The effect of this contamination on human beings was unclear. Were these substances affecting the health of persons other than farmworkers in the immediate postwar period? The invisibility of any link between human illness and a pesticide-ridden environment might have been because there was no such material link in that place at that time, that—as many in agriculture argued—pesticide concentrations were too low to matter. Or it might have been because there was little information that could immediately reveal or even suggest such a link. Archives, including environmental archives, are only created for a purpose. And the reasons for archiving data on pesticide concentrations in water, air, and soil has been to regulate these substances. Where no desire or political will existed to regulate pesticides, there was no reason to monitor them. And so long as they were not monitored, it was that much easier to assert their irrelevance. Any environmental history of the valley stumbles upon the limits, sometimes deliberate, of the written record.



In the absence of environmental monitoring data that could be correlated with existing standards or animal toxicology studies, sick bodies provided the only evidence of danger. In the 1950s and 1960s it had been the undeniable symptoms of farmworkers that had forced the recognition of acute pesticide poisoning. But when the health concern was cancer or any other chronic condition, the latency period between toxic exposures and identifiable symptoms could be months, years, or sometimes even decades. This temporal gap, combined with the mobility of modern individuals, meant that the symptoms of bodies could not be easily connected to particular places. Thus modern assumptions about the separation of bodies and (polluted) environments could not be directly or easily challenged. Even if there were a relationship between health and place, it would have been extremely difficult to see. More difficult questions about the relationship between environment and health in the valley would soon become unavoidable, however. Those questions would find their focal point in the otherwise unremarkable town of McFarland.

## THE McFARLAND CANCER CLUSTER: POLITICS AND PUBLIC HEALTH IN THE 1980S

There was little to distinguish McFarland from its neighboring agricultural towns in the postwar decades. One of several valley communities established shortly after the turn of the twentieth century, McFarland owes its existence to a couple of ambitious land speculators, James B. McFarland and William F. Laird. After buying a large parcel of land from the Southern Pacific Railroad, McFarland and his partner subdivided it into smallholdings and invited struggling farmers and businessmen from southern California to try their luck in the valley, where land was cheaper and the growing season longer.[22] Several decades later the

agrarian hopes of McFarland's early settlers had given way to the realities of industrial agriculture.

Agriculture in the valley continued to become more specialized in the postwar decades. As urbanization forced farming out of southern California, the completion of major irrigation projects in the 1950s and 1960s allowed production in the valley to expand and intensify. The area around McFarland witnessed the rapid expansion of cotton and grape acreage, typically on very large farms, as well the planting of new fruit and nut orchards. Along with this expansion of farming came the increased use of fertilizers and pesticides. In the 1990s the counties surrounding McFarland—Fresno, Tulare, and Kern—accounted for 50 percent of all pesticides used in the state (and California continued to have by far the highest overall usage of any state). This reflected the fact that cotton and grapes—the two most prevalent crops in the region—were responsible for the majority of the region's pesticide use.[23] As the size of farms grew and the demand for labor increased in the decades after World War II, McFarland became one of the valley's farmworker towns. In 1980 more than 70 percent of the population was Latino, and most were employed directly or indirectly in farm labor. Like other farmworker towns in the region, McFarland suffered from seasonal unemployment and endemic poverty. In 1992 it was ranked one of California's ten poorest cities.[24]

McFarland was a town that few people knew or cared about until the 1980s. That two children living on the same street received diagnoses of cancer in 1983 was hardly something that would attract public attention. A few months later, however, a third child who lived a block away was similarly diagnosed. Although the types of cancer differed, the parents of these children began to wonder whether the illnesses were somehow connected. Anguished discussions among the affected mothers marked the discovery of the McFarland cancer cluster. Epidemiologists working for the state of California would eventually confirm thirteen cases of childhood cancer in a town of only six thousand people. Although only a small number of people were directly affected, the rate of childhood cancer in the community was more than three times what would be typically expected. Most of the cancer cases occurred in a single neighborhood of small stucco homes built in 1980 with financing from the Farmworkers Mortgage and Housing Authority (FMHA).[25]

Connie Rosales, the mother of one of the sick children, contacted the Kern County Health Department for answers. Local public health officials responded slowly. They initially assumed that there was no cluster. As residents' concern and frustration grew in the face of the local government's inaction, residents looked elsewhere. Rosales contacted the local branch of the Mexican-American Political Association (MAPA) for help. Eventually her letter arrived at the office of state senator Art Torres, a leading Latino politician in the state who was also known as an aspiring gubernatorial candidate. In May 1985 Torres announced that his committee, the Senate Committee on Toxics and Public Safety Management, would hold hearings in McFarland. Those hearings drew the attention of newspapers and television and elicited anguished testimony from residents, including Rosales. With political scrutiny now cast on Kern County, the board of supervisors declared a public health emergency. At that point, the state agreed to provide the local health department with funds to initiate a detailed study of the stricken neighborhood.[26]



Residents immediately suspected that the environment was the source of the illnesses. The widely publicized problem of groundwater contamination, in particular the valley's DBCP problem, had sensitized many residents to the health threats of chemicals. Having been alerted to the problem of nitrates in the water from notices on her monthly bills (which warned against giving the water to infants), Rosales wondered whether the same contaminants might be responsible for the cancers. Deferring to these concerns, health officials conducted nitrate tests on the local water supply. When levels were found to be within established public health limits, officials began to test for other substances. First they tested drinking water for several pesticides (including DBCP), toxic metals, and ionizing radiation; then they tested the soil around the homes and schools of cancer victims. They followed the soils tests with air monitoring for carbon monoxide (a product of the freeway that runs through the middle of the town). They also tested the inside of victims' homes for radiation, asbestos, formaldehyde, and other carcinogenic chemicals. Kern County investigators certainly found contamination in McFarland, but it was not exceptional contamination; in fact, all soil and groundwater contaminants fell within established public health limits. Officials declared the environment "safe," though none went so far as to say that it was healthy.[27]

Residents were not satisfied. In their minds (and many others') the existence of so much disease in one place pointed to the local environment as the likely cause. As in other struggles over toxic contamination, those least willing to yield to the assessments offered by government officials were women. Initially the leading activists in McFarland were mothers of cancer victims. Women typically assume responsibility for the well-

being of their families, and since the late nineteenth century this obligation often has pushed them into the public arena to fight for safer environments. Like that of the "municipal housekeepers" of the late 1800s and the antimosquito crusaders of the 1910s, the activism of the McFarland mothers emerged from their desire to protect their families' health. Women, moreover, often have access to different kinds of information—that gathered through observation and conversations with other women. They, more frequently than men, are at home and in the community and therefore usually more aware of the everyday hazards their children encounter as well as subtle changes in their physical well-being. As mothers in McFarland became more aware of the prevalence of sickness and the rumored and known environmental dangers, they began to develop their own hypotheses about the cancers and to press health officials for better answers.

It was not only their social positioning that enabled women to speak out against perceived environmental health threats but also the different ways in which gendered bodies have been envisioned and experienced. As in earlier periods, the permeability of the late-twentieth-century body remained strongly connected to gender. The construction of the female body as especially vulnerable to occupational hazards had underwritten protective legislation for women, as well as sex discrimination in the workplace, for decades. Although these distinctions were strongly challenged in the 1960s by feminists (who insisted on the strength and resilience of female bodies) and environmentalists (who insisted on the permeability of *all* bodies), other developments reemphasized the significance of bodily difference. In particular, new concerns about the vulnerability of the fetus helped reinscribe the belief that women's bodies were more porous than those of men. Ideas about pregnancy and fetal health were transformed by the discovery that viruses and drugs (such as thalidomide) could cross the placenta. By the early 1980s prescriptive prenatal advice emphasized that pregnant women should avoid drugs, alcohol, and toxic chemicals. Not surprisingly, the women in McFarland worried about the pesticides they had encountered when they were pregnant, as well as the contaminated environments in which their children played. From their perspective, the spatialization of disease was related to the uses of the local landscape: the heavy application of pesticides, the contamination of groundwater, the ongoing problems with air quality. If they were to believe that the environment was not the cause, the mothers insisted, public health officials had to provide another explanation.[28]

Although the McFarland mothers challenged the disinterest of public health officials, they did not at first challenge modernist conceptions of the issue. They cast their hypotheses in terms of specific contaminants, and their principal concern was the town's water supply. To the extent that McFarland's activist residents shared the modernist framing of the problem, it may have been because that was the only way in which they saw the problem. Or it may have been because that was the only kind of argument that could gain traction within the existing regulatory system.



As media and political interest in McFarland intensified, public health officials struggled to put together a coherent response. As community members asked more questions, the limits of the existing regulatory framework became obvious. Until the crisis, there had been no monitoring of pesticides in the local environment. And though the surrounding environment in McFarland met "existing standards," public health officials acknowledged that the relationship between environment and health might not be fully encapsulated by those standards. Water quality standards existed for only a handful of pesticides, and there had not yet been any attempt to assess and regulate pesticides in air. The lack of knowledge generated more anxiety. Concerns about McFarland's environment were so intense that in 1985 the FMHA placed a moratorium on building in the community.[29] As one health official acknowledged, "The variety of chemicals being introduced into that environment gives you any number of possible sources of environmentally induced damage."[30] Soon afterward, the California Department of Health Services (CDHS) confirmed another childhood cancer cluster in the nearby town of Fowler.

In the 1950s the investigation of pesticide-poisoning among farmworkers had fallen to specialists in occupational health, who drew on their background in toxicology and factory environments to craft a response. Under mounting pressure to do something about the McFarland situation, health officials now turned to epidemiology. In contrast to bacteriology, which focuses on disease in individuals, epidemiology studies the occurrence of disease in populations. By looking at the spatial patterns of disease occurrence, epidemiologists try to uncover common causes of illness. The discipline's roots are typically dated to John Snow's famous investigation of a cholera outbreak in mid-nineteenth-century London. By mapping where the sick individuals lived, Snow traced the source of cholera to a single contaminated well.[31]

By World War II, epidemiology, much like occupational health, had become a somewhat marginal subfield of biomedicine, eclipsed by germ theory and the successes of laboratory medicine. Then, in the 1950s, the

field attained new prominence when epidemiologic studies provided insights into the causes of lung cancer and heart disease—the two most prevalent forms of chronic illness in the United States. The crucial difference between postwar epidemiology and bacteriology lay in how these specialties described disease causation. Instead of emphasizing a single agent responsible for disease, epidemiologists embraced the idea that causes were multiple. And instead of trying to specify the precise mechanisms of disease etiology, they attributed disease to the interaction among a series of variables, or "risk factors," whose actions were only incompletely understood. The dominant metaphor within the field was the "web of causation."[32]

In California epidemiology had attracted some attention in the 1930s as a tool for studying infectious disease, notably in Karl Meyer's studies of sylvatic plague and western equine encephalitis. However, epidemiology would only become institutionalized in the California Department of Public Health in the 1950s. The reason lay not with infectious diseases such as plague but with the new problem of smog. As air quality in Los Angeles emerged as a major political issue, the CDPH found itself tasked with determining whether and to what extent community-wide pollution threatened public health. These early air pollution epidemiologists acknowledged that they were less concerned with identifying the precise cause of disease than with preventing illness, and they often invoked nineteenth-century models. As the state's leading smog researchers declared, "Just as epidemiology led to methods for control of waterborne disease before bacteriology permitted the accurate diagnosis of them, so it is hoped that epidemiology may assist in the control of the health effects of air pollution even before it is possible to diagnose a disease caused by air pollution."[33]

The turn to epidemiology emerged from the desire to know whether disease was in fact spatialized, the result of living in certain modern landscapes. In the case of air pollution, many laypersons already assumed that it was. Those same concerns would soon be extended to chemical pollution. A critical moment came in 1975 when the National Cancer Institute published the *Atlas of Cancer Mortality for U.S. Counties*. Each page of the *Atlas* presented a national map with individual counties color-coded to illustrate the local mortality rate of specific cancers. Dark red sections, indicating a "significantly high" mortality rate, stood out against the olive green color that represented average rates. Aggregations of red sections seemed to signal ominous cancer hot spots. The *Atlas*, much like Thomas Logan's isothermal maps, visually linked disease and place.[34]



In the 1970s the national media seized on the implied link between environmental pollution and cancer. Articles on the subject proliferated in publications ranging from *Newsweek* to *Reader's Digest, Scientific American* to *Vogue*. Several popular books took up the issue, most notably Samuel Epstein's *Politics of Cancer*, which unequivocally attributed rising cancer rates to the postwar rise of the petroleum, chemical, and pharmaceutical industries, as well as to the increasing use of pesticides and food additives.[35] Many in the research community, while considerably more circumspect than Epstein, shared the concern with environmental carcinogens. As the cancer researcher John Higginson put it in 1976, rising cancer rates "should be considered due to the entry of new agents into the environment or increased exposure to old ones, until proved to be due to better diagnosis or other forms of artefact." At the same moment, the catastrophes of Love Canal and Three Mile Island made the public acutely aware of their vulnerability to environmental contamination. And following the passage of the Superfund legislation in 1980, the EPA began identifying toxic hot spots across the country.[36]

At that point, California's public health officials expanded their environmental epidemiology work from air pollution to chemical contamination. After the discovery of DBCP in Central Valley groundwater, the state legislature demanded an assessment of health effects. The CDHS responded with an epidemiologic study that examined the association between groundwater contamination and cancer rates in the Fresno area. At the same time, officials discovered that groundwater in northern California's Silicon Valley was polluted with a carcinogenic solvent (1,1-tricholoroethane) that emanated from leaking underground storage tanks at the Fairchild Semiconductor facility. Again the agency undertook an epidemiologic study in response to public and political concern. Both of these studies suggested a link between contamination and the clustering of disease. And while the Fresno DBCP study initially attracted little attention, the Fairchild studies were widely covered by the press. Whatever its limitations, epidemiology provided a scientific language for talking about the relationship between the modern environment and the prevalence of disease and offered a means for evaluating the effects of chemicals "in the field."[37]

After the initial environmental tests in McFarland had revealed no obvious contamination concerns, public health officials bowed to public pressure and began a small epidemiologic study. With advice from the state Department of Health Services, the Kern County Health Department began a case-control study of ten affected individuals and twenty unaf-

fected individuals (controls) selected from the same community. The goal was to identify whether the exposures or lifestyles of sick individuals in the community were significantly different from the exposures and lifestyles of healthy individuals. Researchers proceeded to render complex lives and environments into a set of rote questions whose answers could be statistically tabulated: Where have you lived and worked? What do you normally eat? Do you smoke, and how much? What illnesses have you and your relatives suffered from? What are your hobbies? Have you been exposed to pesticide sprays? To paint, lacquer, or varnish? To hair dyes?[38]

The case-control analysis, completed in October 1986, was inconclusive. Nor did it stem mounting public concern. In fact, the controversy intensified later that year when the UFW produced a video about McFarland to support their call for a renewed grape boycott. Featuring Connie Rosales and several other McFarland parents, *The Wrath of Grapes* asserted that the cancers were a direct result of growers', in particular grape growers', intensive use of pesticides. The involvement of the UFW angered the local public health establishment, along with farmers and political leaders who were openly hostile to the union. The politics grew only more charged when Thomas Lazar, a medical anthropologist hired by Kern County to work on the cluster investigation, quit his job and went to work for the UFW. Lazar claimed that county health officials were covering up the extent of the cancer problem and told the press that existing data suggested childhood cancer rates were high not only in McFarland but also in several other county communities. Although health officials insisted that Lazar's charges were baseless, they would eventually confirm the existence of clusters in two more San Joaquin Valley communities (Rosamond and Earlimart). That fall, the McFarland and Fairchild controversies contributed to the overwhelming passage of Proposition 65—the Safe Drinking Water and Toxic Exposure Act—which forbade any business to knowingly pollute drinking water with toxic chemicals (defined as those suspected of causing cancer or birth defects) and which required that the public be notified of any exposures to known or suspected carcinogens.[39]

Amid these developments, the CDHS agreed to expand their environmental studies in McFarland by gathering data on pesticide use in the area and testing for electromagnetic and radio-frequency radiation (a product of a Voice of America transmission tower located just north of town). Lazar's charges also rekindled the interest of state politicians in McFarland. Senator Torres held another hearing in October 1987, which elicited a barrage of testimony, both angry and emotional, from residents



who felt that the state was not doing enough to protect them. After the 1987 hearing, Torres argued that the entire San Joaquin Valley should be declared a toxic waste site under the state Superfund law. Bakersfield's state assemblyman, Trice Harvey (a Republican), asked the governor to declare McFarland a disaster area so that emergency funds could be made available for a broader investigation. Soon afterward, officials announced that low concentrations of DBCP had been found in one of the town's wells, intensifying the sense of panic. Then, in spring 1988, presidential candidate and civil rights activist Jesse Jackson made McFarland the centerpiece of his campaign in the California primary. Jackson visited affected families and held a news conference. Accompanying Jackson were prominent political figures, Hollywood celebrities, and the national media. Soon after, the governor announced the formation of a "blue-ribbon advisory panel" to oversee the work at McFarland.[40]

As Jackson's visit made clear, environment and health concerns in McFarland were intertwined with issues of race and class. The historical experience of Mexican American communities in the West, racialized divisions of political power, and the influence of agribusiness in California all fostered a deep distrust of government in McFarland's Latino community. Jackson insisted that the environmental problems at stake in McFarland could not be separated from the issue of Latinos' political disenfranchisement in the valley. Marion Moses, a physician and UFW activist who had worked on pesticide issues since the late 1960s, told a reporter that "if this were happening in a white, middle-class office building, something [more] would have been done." Connie Rosales contrasted the response to McFarland with that to Love Canal, noting that residents of the latter community, who were overwhelmingly white, had received both political attention and government funds even though no one there had actually died. Many others voiced similar sentiments to reporters. "We just don't count for much," remarked a field worker and father of one cancer victim.[41] Adam Salinas, a resident of Earlimart, suggested that "maybe they [government officials] don't pay attention to poor people because they're poor."[42] These charges of racism and classism were fueled by the fact that, locally, political power was divided starkly along racial lines. Although almost 90 percent of the population was Latino, the white minority controlled the local government. As late as 1988, McFarland had only one Latino elected official. Important institutions—the city council, the water company, and the county health department—were dominated by whites, and less than 10 percent of the Latino residents were registered to vote.[43]

The influence of race and class was undeniable, and this was the fact that the press coverage tended to highlight. However, those divisions were not all-encompassing. There were at least a few Latinos who thought the activists had overstated the problems, and there were many middle-class whites who voiced their concern. There were also white farmers in the region who feared the long-term health effects of pesticides and who argued for less chemical-intensive methods of farming. Among farmers and middle-class whites, it was often the experience of cancer in their own families that pushed them toward this ecological view. The knowledge that DBCP was linked to both sterility and cancer had reportedly spurred many farmers to avoid it, despite the lack of a good replacement.[44]

The stance of the state toward the community was more predictable, though hardly singular. The "official" reaction to the cluster often varied. Most obviously, the political spotlight and upcoming election motivated an otherwise disinterested governor to make available some funds to study the problem. Within the bureaucracy itself, attitudes toward the cluster differed starkly among agencies. The slow response of the county health department was a result of both its sensitivity to local politics and its unpreparedness. Like most health departments in the early 1980s, the Kern County Public Health Department was staffed with sanitationists and headed by an M.D.; it had no expertise in epidemiology. The most critical division, however, existed between the Department of Health Services and the far more powerful Department of Food and Agriculture. Not surprisingly, those working for the health department were more sympathetic to residents' concerns and to the possibility that pesticides might be causing chronic health problems, though they were dismissive of lay hypothesizing and frustrated by residents' skepticism about their methods and expertise. Individuals at the CDFA, on the other hand, were critical of any explicit focus on pesticides.[45]

In January 1988 the CDHS released a preliminary report that suggested a tentative relationship between childhood cancer and parental exposure to certain pesticides. Although officials would soon back away from this conclusion citing a lack of evidence, these findings intensified the political spotlight on McFarland. Moreover, in the process of conducting that study, researchers had identified the third cluster (in Rosamond). In light of these findings, the advisory panel debated whether to suggest more intensive monitoring for pesticides or, alternatively, more epidemiological work. Although community members had lobbied for more environmental monitoring, the blue-ribbon panel opted for epidemiology. Given the opposition of agricultural interests and the



CDFA to pesticide monitoring, epidemiology was the less controversial option. Based on the panel's recommendation, the CDPH agreed to conduct what it would call "the four-county study"—a multicommunity study of cancer incidence in the four southern counties of the San Joaquin Valley. The goal was to compare the frequency and distribution of childhood cancer in the state's most pesticide-laden communities to that in other, hypothetically less contaminated regions. The hypothesis underlying their effort was that California's agricultural communities, subject as they are to high levels of pesticide exposure, might show an elevated cancer rate. Put another way, the question was, could modern epidemiology confirm that the San Joaquin Valley was a pathological space compared to other locations in California? The discovery of a fourth cancer cluster in fall 1989 (in Earlimart) elevated the concern that the valley was indeed such a pathological space.[46]

The decision to conduct the study was itself significant. It demonstrated that residents had attracted the attention of the state health establishment and that they had succeeded in changing the question that experts were asking. In 1984 the question had been, what individual exposures might have contributed to the cancers? In 1989 the question was far more radical: was the pesticide-laden environment of the valley increasing the risk of cancer among the entire population? Three of the four cancer clusters occurred in communities located in the valley's agricultural bottomlands, which were surrounded by fields of cotton, grapes, and citrus. All lay above the polluted aquifer on the valley's eastern side. The study's hypothesis was that the state's rural regions were more subject to certain diseases than its cities—not because they were insufficiently modern, but because of the very nature of their modernity. As one local health official described it, the San Joaquin valley was the site of a "grand experiment" on the human effects of pesticides. The four-county study asked whether modern agriculture had respatialized disease, creating a new form of miasma—an ill-defined pollution that permeated local landscapes and entered bodies in multiple and unknown ways.[47]

The study continued for two years. When the results were announced, they revealed far more about the limits of epidemiologic knowledge than about the material relationship between environment and disease. The scope of the study had been constrained by the fact that reliable cancer data were available only since 1987—the year that a state tumor registry was implemented in response to the McFarland crisis. The study itself was an elaborate statistical analysis that compared rates of specific cancers to those that might be expected based on national averages and

those predicted by standard statistical distributions. In September 1991 the CDHS presented its conclusions at a public meeting while the UFW held a protest against pesticides outside. Lynn Goldman, then the state's lead epidemiologist on McFarland, summarized the years of work on the cancer cluster and concluded by stating that nothing in either the environment or the lifestyles of McFarland's residents could explain the cancers. As Goldman and others would write in a technical article, there was no "strong force of morbidity" operating in the region. Goldman emphasized that the aggregation of so many cases might, after all, be simply random, or, alternatively, there might be some "force of morbidity" that was not strong enough to detect with existing statistical techniques. In their report the investigators discussed the statistical challenges presented by data sets with small numbers and large variances—an implicit acknowledgment that statistical epidemiology often obscured, even when it did not disprove, what seemed otherwise evident at the level of experience. In the absence of conclusive evidence that the cancers were linked to environmental causes, the professional assumption was that they were not, which was also the answer that most of the state's political leaders had wanted to hear. The cluster, while undeniably "real," had no cause that modern epidemiology could identify, and, they insisted, it likely had no cause at all.[48] The panel disbanded itself and advised the state to formally end its investigation. "Science," they insisted, had nothing more to offer on the subject, and thus it was time to move on.

Some people, especially business and agriculture representatives, took the failure of epidemiology to link environmental contamination to the cancers as evidence of the normalcy, or at least the irrelevance, of McFarland's environment. The pathology of cancer could still be assumed to lie within the body and, in this case, within the already pathologized bodies of those who were ethnically Mexican.[49] Although ecological views had challenged this racializing logic, they had by no means supplanted it. In this view, disease and health suggested nothing about environmental change or the region's chemical-intensive agriculture. Although the agriculture industry did not invent modern understandings of health, modernist models of the body remained powerful in part because they continued to serve certain groups well. The notion of an impervious body and a passive environment continued to underwrite the project of industrial agriculture in the San Joaquin Valley.

Many residents, however, were deeply frustrated by the inconclusive results. They took the results of the study as evidence of the inadequacy



of epidemiology and the modern regulatory system. Community members had hoped for a definitive scientific explanation. When the state's epidemiologists could not provide it, some community members refused to yield to an ambiguous expert knowledge that exonerated the local landscape while failing to answer their most pressing question: What had caused the cancers? Of the experience in McFarland, one activist commented cynically, "We've learned over and over again that the studies produce statistics to be analyzed away; that the tests produce numbers to be classified into safe levels or standards; and that experts can find ways to explain away anything." What seemed evident at the level of experience became invisible in the languages of modern public health and biomedicine. Connie Rosales put her frustration still more bluntly when she told a reporter that "the science of epidemiology needs a real kick in the rear end." The more officials insisted that the environment was "safe," the less people believed them. Despite the assurances of experts, many families chose to move away from McFarland; others lamented their inability to do so.[50]

Among those who were disillusioned by the failure of epidemiologists to connect the environment to health, there were several responses. Some maintained that health officials were engaged in a cover-up and were simply unwilling to confront powerful agricultural interests on the issue of pesticides. In this view, the dynamics of power combined with institutionalized racism to shape the scientific findings. Others tried to critique modern public health on its own grounds, arguing that the environmental investigation had not gone far enough. Several community leaders became reasonably well versed in the languages of environmental science and epidemiology, and they prodded officials to test for additional chemicals, to use lower detection limits, and to include more cases in their epidemiologic analysis.[51]

Others simply disbelieved the results, although they could not articulate precisely why. Most laypersons remained wedded to the validity of their own experience in the landscape and, like nineteenth-century physicians, continued to meld modernist with environmental understandings of disease. Regardless of what epidemiology might suggest, residents still *felt* that the landscape was toxic, that their bodies were instruments that measured things that epidemiology and toxicology apparently did not. They insisted that a lifetime of experience in the Central Valley provided them with knowledge that experts in laboratories or distant offices lacked or chose to ignore. After all, it was community members rather than public health experts who first identified the cluster. Lois Gibbs,

leader of the community group at Love Canal and subsequently a prominent antitoxics activist, defended this approach. Local people, she insisted, "know when something is wrong. They can see dead vegetation, smell chemical odors, taste the foulness of their drinking water, and observe an increase in disease."[52]

Residents of McFarland echoed Gibbs's view. Many homes sat within ten feet of cotton fields, and residents complained of pesticide spraying and especially the use of defoliants—chemicals that cause plants to drop their leaves. Defoliants were sprayed extensively around McFarland each fall prior to the cotton harvest. Community members told health officials about floodwaters that smelled of chemicals and petroleum, and complained that their drinking water was often discolored and tasted bitter. They reported smelling pesticides in the air throughout the year. They pointed to an unusually large number of sick animals in the area. Many in the town were farmworkers and had experienced firsthand the chemicals that were applied to the surrounding landscape; many had been ill in the fields or had watched as coworkers fell ill. One field worker, Jaime Caudillo, said as much, telling a reporter, "If we get sick from it, the children must absorb some of it." In ways that echoed nineteenth-century understandings, McFarland's residents drew analogies between the landscape and their bodies, reading the reactions of plants and animals as evidence that they, too, inhabited a pathological landscape. As another resident put it, "It seems so obvious to me. The pesticides kill bugs, so why not us?" From this perspective, cancer was part of a continuum of pesticide-induced diseases that workers in the region had been familiar with since the 1950s: rashes, "rubber legs," nausea, seizures, and even death. At least one farmworker had made this connection more than a decade earlier when she suggested that acute pesticide poisoning might also be linked to rising rates of cancer and other chronic diseases.[53]

This is not to say that the residents of McFarland were better epidemiologists than those who worked for the state health department but merely that they understood at some level that the abstractions of modern biomedicine, along with its narrow definition of causality, might be deeply problematic. While residents shared modernist assumptions about disease, they also held open other possibilities.

## RESURRECTING MODERN BODIES

Why linger over the problems of one seemingly insignificant community? McFarland was but one small town, in one valley, in one state. But



if knowledge is local, then localities (other than the locality of the laboratory) are critical. And much of the knowledge about chemicals and environmental health in the late twentieth century emerged from particular places, from the reactions of individual bodies that were located in specific environments. Knowledge has a complex geography. Even in the late twentieth century, knowledge about bodies and environments could still be produced in multiple places—in toxicological laboratories and within the computers of professional epidemiologists, but also in the valley's fields and orchards and on the streets and playgrounds of McFarland. Moreover, understandings of disease and health cannot be separated from the social and political contexts in which they arise. In McFarland, this context included farmworkers' experience of pesticides across more than three decades, a history of racializing logic within the supposedly scientific discourses of biomedicine, and the political marginality of California's ethnically Mexican communities.

Moreover, although the issues at play in McFarland were local, they resonated elsewhere. The attention of the national media, as well as state and national political figures, indicated that McFarland's troubles had broader relevance. The town's plight was symptomatic of a growing concern with the health effects of modernity across the valley, the country, and even the industrialized world. Reports of cancer clusters surged over the course of the 1980s; one study found that state health departments received roughly fifteen hundred requests for cluster investigations in 1989 alone.[54] Although only a fraction of these requests became major public health controversies, whenever controversies emerged they inevitably pitted the residents of polluted communities against local governments and public health officials. Increasingly, laypeople refused to accept the assurances of experts about the safety or irrelevance of polluted environments. Taken together, these controversies signaled that modernity could no longer be automatically associated with health; in fact, many felt the opposite was true.

Among professionals, the rising skepticism about expert knowledge in the late 1980s was attested by the proliferation of studies on "risk perception"—an area of sociological research whose aim was to explain why laypeople did not always accept professional assessments of technological and environmental risks. Social scientists now analyzed why the public often resisted the reassurances of experts regarding the safety of things such as pesticides and nuclear power. Why did laypeople become so concerned about pesticides when they still smoked and drove cars, activities that—statistically—were far more likely to kill them? In

a particularly modern irony, a whole new field of expert, managerial knowledge had developed to explain why those types of knowledges were no longer authoritative.[55]

The emergence of such different perspectives on disease is often explained as a problem of rationality, or, more to the point, irrationality. Experts emphasize the inability of laypersons to fully comprehend the relevant science. In an effort to produce knowledge that is supposedly "universal," modern science relies on a scale of analysis that is typically either far below or far above that of lived experience. It emerges from the laboratory, or from the statistical analysis of large populations. Science reduces individual experience and history to certain forms of quantitative representation: numbers representing pollutant levels and probability, graphs and diagrams that show the presence or absence of imagined relationships. Because they cannot understand the abstract representations that are scientists' stock-in-trade, or because they cannot suppress their emotional response to illness, the argument goes, laypersons often misinterpret or ignore the objective evidence.[56] On the other side, activists frequently assert that government scientists are guilty of cover-ups, or at least are unwilling to pursue aggressively the relevant questions because they do not want to confront powerful interests.

Yet the issue is not simply that laypersons cannot read the scientific evidence or that government scientists always serve power but that there exist different types of experience, different forms of knowledge, and different understandings of disease and health—though these are seldom made explicit.[57] In the case of McFarland, modern and ecological concepts of health were both in play—and where an individual stood on the cancer cluster had much to do with the model that he or she relied on.

Epidemiology itself is something of a paradox in this respect. Epidemiology had initially been applied to environmental health issues because, in contrast to toxicology, its multicausal approach could take into account the complexity of actual human bodies and their environments. Epidemiology, at least in certain forms, is explicitly ecological in its approach. But as residents of McFarland gradually realized, epidemiology (much like occupational health) was ecological in a somewhat superficial sense. In many ways modern epidemiology invoked much of the logic if not the methods of modern bacteriology. Ultimately, epidemiologists still envisioned bodies as idealized entities that were distinct from their environmental context. And while acknowledging the multiple possible causes of disease, most epidemiological studies set out to identify discrete "risk factors." For instance, in a case-control study investigators look for substances that sick persons were exposed to but which the controls were not. The goal of such a study is to link a specific exposure to a specific outbreak of disease: those who drank from a given well contracted cholera (or cancer); those whose water came from elsewhere did not. In this model, disease is still highly localized—in a given infectious agent, a certain well, an individual body. Routes of transmission are narrow and traceable and are subject to verification in the laboratory. Thus, while epidemiologists acknowledged that the causes of disease were multiple and could interact in complex ways, in practice they sought to verify independent, or nearly independent, cause-and-effect relationships. Chemical contaminants were conceptualized as akin to microbes, as singular "agents" that could induce disease once they entered the body. Moreover, only those exposures that could be quantitatively measured and linked to cancer through toxicological studies were deemed legitimate risk factors. As in occupational health research, bodies and environments were presumed to interpenetrate one another but only in limited ways that were subject to both measurement and control.[58]



On the whole, epidemiological studies of cancer in the postwar period have tended to validate those risk factors that can be directly ascribed to individuals (e.g., smoking cigarettes); other, more social factors that might contribute to disease routinely fall out of the analyses because they cannot be adequately quantified, because they are viewed as something less than truly causal, or because they are subordinated to other individual factors. Even when it takes into account ostensibly social or environmental factors, epidemiological research often treats them as independent qualities of individuals.[59] For example, in the DBCP/cancer study that CDHS epidemiologists conducted in 1982, investigators found a positive association between three types of cancer and rising DBCP levels. But they also discounted their study as inconclusive; the primary reasons were race and class. As they explained, the census tracts with higher rates of stomach cancer were both poor and predominantly Mexican American, and Mexican American ethnicity was suspected to be a risk factor in stomach cancers.[60] Implicit here was the possibility that Mexican American populations in the Central Valley might have a higher cancer rate because of their lifestyles (e.g., their typical diet) or because they were genetically predisposed to stomach cancer.

But the relationship among "race," environmental contamination, and the incidence of cancer is likely far more complex. Given how long and how deeply race and disease have been intertwined, it is impossible to fully disentangle the relationship between them. In some cases, "race"

may indeed serve as a crude approximation for specific populations that share certain biological or "lifestyle" characteristics as the epidemiologic approach assumes. What the DBCP and other such studies typically failed to acknowledge, however, was that "race" was also entangled with a person's access to medical care, exposure to various toxic substances, and presence in certain kinds of environments. Histories of workplace and residential segregation have located different kinds of bodies in different places. As the history of pesticide poisoning among farmworkers makes clear, nonwhites and the working class have routinely found themselves exposed to dangerous environments that more privileged individuals have been able to avoid. Segregation has combined with racist policies to ensure that race and class are unavoidably intertwined with environmental quality at the level of everyday life. Nonwhites do have higher incidences of certain cancers; they are also far more likely to work in more hazardous jobs and live in more polluted communities. Latino farmworkers are among the most disadvantaged in this respect.[61]

Race, class, and environmental contamination are thus not independent "variables" for which researchers can statistically control. To the contrary, histories of segregation and the differing quality of local environments, along with any relevant shared genetic traits, have combined to help produce "race" as a meaningful category in epidemiologic research. Material differences in the environments that people occupy have helped to produce physical differences in specific bodies (which also happened to be racialized): depressed cholinesterase, sterility, chronic respiratory problems, perhaps even cancer. In the case of pesticides, it is not hard to see how environmental and social history may be critical factors in the production of disease. Because people do not live their lives in laboratories, the predisposition to disease is never solely a property of the individual; it is also the outcome of a person's relationship to a preexisting social structure and to a series of material environments. But when epidemiologists control for "race," the environmental experience of racialized populations is implicitly excluded from their analysis. Such reasoning, though seemingly nonracist to the authors of the DBCP study, nonetheless had the effect of again positioning Mexicans and Mexican Americans as poorly disciplined and uniquely susceptible bodies. In this way, epidemiologic research has often reproduced a long-standing racial logic that their authors otherwise sought to avoid. Moreover, by directing attention toward the inherent qualities and individual habits of those bodies, epidemiology had the effect, however unintentional, of directing attention away from the environments in which Mexicans and Mexican Americans typically lived and worked, such as the pesticide-laden fields of the Central Valley. It is often easier, or seems somehow more "logical," to ascribe disease to race rather than place.



In McFarland, those who rejected the conclusions of epidemiology pointed to this modernist tendency to locate disease within individual bodies, and the consequent failure to account for their own complex environmental and social histories. From the beginning, activists were skeptical of the trajectory that the McFarland research was taking. Teresa Buentello minced no words when she told a reporter, "They think we're a bunch of Mexicans, and we probably have it in our genes." Connie Rosales angrily recalled that health officials investigating the cancers had initially inquired about the use of Mexican herbs and traditional remedies instead of focusing on pesticide exposures and working conditions. Others insisted on the critical importance of the local context and astutely critiqued the laboratory paradigm on which both toxicology and epidemiology were based. As one of the mothers put it, "The pesticide DBCP showed up in our well, but they say it was below the level of danger. They know this from their rat tests. But the rats were exposed to DBCP alone. What if they gave rats the DBCP, and then exposed them to all the other chemicals we are exposed to here in McFarland? What would happen to their rats then? Nobody knows. I think they'd end up dying."[62]

The state's epidemiologists, on the other hand, were frustrated but not especially surprised by their inconclusive results. At least some of them felt that their studies of McFarland had always been driven more by the need for political leaders to demonstrate their concern for the situation than by the expectation that they would uncover meaningful information. In fact, during the 1980s, while the state's McFarland studies were under way, the attitude of the public health profession toward cancer cluster investigations had undergone a clear shift. In the 1960s and 1970s, as environmental concerns had risen to prominence, public health experts had advocated the use of epidemiology to investigate the relationship between environmental contamination and disease clusters, but by the mid-1980s the profession almost uniformly regarded such studies as a waste of effort. There were several reasons for this shift in attitude. At the federal level, the "Reagan revolution" had turned the government's attention (and dollars) away from issues of environmental contamination and public health. As government services were squeezed in the 1980s, state and local health officials were forced to make difficult decisions. In California, Governor George Deukmejian, a conservative

Republican, slashed the budgets of the state's regulatory and social service agencies, to which he was openly hostile. In that political climate, disease clusters became a low priority. Detailed environmental studies were costly, and the number of people with cancer in communities like McFarland, while statistically high, was numerically quite low. Overwhelmed by other concerns—food-borne illness, infectious disease outbreaks, and the emergence of HIV/AIDS—state and local health officials spoke of "getting more bang for their buck" and actively discouraged cluster investigations.[63]

But it was not only impoverished public health departments that shunned cluster investigations. So did university researchers. They pointed out that although a few studies had suggested links between disease clusters and environmental contaminants, none had produced definitive results. Researchers lamented that even where "true" clusters could be confirmed, it was not possible to link them conclusively to environmental conditions, given the small sample size and the insufficiency of available environmental data. Residents came and went, they behaved differently, their memories were unreliable. Likewise, the environment itself was always changing, and the relevant variables could not be controlled or even assessed. New pesticides were introduced; old ones moved into air and groundwater and were carried away. Relevant historical records, in particular records of pesticide use, were sketchy or nonexistent. With cancer, the relevant exposures likely occurred some time earlier—weeks or years or decades prior to any diagnosis. Like farmworkers, residents were unlikely to know what contaminants they had encountered over time. And whereas individuals could at least be asked about the source of their water or their food or how much they smoked, they had no idea what pesticides they might have been exposed to over the course of their lives. The decades-long failure to measure pesticide levels in the environment made it impossible to assess individuals' exposure in the quantitative manner that epidemiology required. Data, after all, are gathered for a reason. By the 1980s, when limited environmental measurements were finally available, human exposures to pesticides in the valley were so widespread that they defied complete identification much less quantification. Moreover, in cases of environmental contamination, everyone in the community or neighborhood was likely to be exposed to some degree; thus, there might be no truly unexposed persons who could serve as scientific controls.[64] The complexities of the modern environment made it profoundly difficult to create a set of research methods that could even begin to approximate the norms established in the laboratory.



Moreover, the political and liability issues that surrounded environmental contamination meant that that any such study was likely to come under intense scrutiny from industry-backed scientists and also by the courts—and many did. As more and more questions were raised about methodology, several leading epidemiologists offered their own critiques of the field. Some criticized epidemiology for its inattention to the underlying (biological) mechanisms of disease production, comparing it unfavorably to fields like microbiology. Others argued that even in comparison to animal studies of toxicity and risk, ecological studies of exposure were inadequate because they failed to control sufficiently the relevant variables. In other words, so-called environmental epidemiology was repeatedly criticized as a kind of second-rate field science, fatally hampered by the inability of investigators to control the complex social and environmental realities encountered outside the walls of the laboratory.[65] Even though the laboratory had obvious limits, particularly when the concern lay with environmental sources of disease, the laboratory paradigm remained the standard by which any model of the body and its illnesses would be measured.

Many practicing epidemiologists became openly critical of efforts to apply their methods to issues of environmental contamination, especially to cancer clusters. Several authors outlined the technical problems with such efforts in the field's leading journals, emphasizing that most suspected clusters turned out not to show elevated cancer rates on closer investigation. Richard Jackson, who had worked on the DBCP investigation for the state of California and later moved to the Centers for Disease Control (CDC), noted that among professionals cancer clusters were referred to as the "epidemiologists' fool's gold"—something you shouldn't spend your time chasing because it was scientifically valueless. As researchers refined their statistical techniques and analyses, many argued that clusters were probably chance events. In 1990 the *American Journal of Epidemiology* published a special issue dedicated to cluster studies. The journal's editor, Kenneth Rothman, opened that issue by declaring that "there is little scientific value in the study of disease clusters." That same year the CDC announced that it would no longer routinely assist in cluster investigations, citing their cost and ineffectiveness. For scientists, cancer cluster investigations offered only a research dead end. The realities of places such as McFarland did not conform to the strategies and methods of modern biomedicine, so most epidemiologists turned away from them.[66]

Thus, although the turn toward epidemiology in environmental health

research initially promised a more environmental approach, in most cases environmental epidemiology has ultimately reinforced modern concepts of the body, as it did in McFarland. By failing to confirm environmental contamination as the source of disease, epidemiology reinforced the belief that individual factors were the better explanation. In McFarland, some took the epidemiological work as an exoneration of the "environment" and pesticides in a broad sense and therefore as license to ascribe the cancers to genetics and "high-fat diets." But even for those researchers who genuinely want to modify the reductionist focus of biomedicine there is, as Robert Aronowitz has observed, a seemingly inescapable tendency to gradually abandon an initially "holistic" approach in favor of a more "ontological" and reductionist one. Over time, as innovative researchers seek legitimacy for their claims, they often recast their hypotheses in narrower and more specific terms. They begin to formulate hypotheses that more closely conform to the time-tested models in their field. The paradigm and limits of laboratory science subtly shape the kinds of questions that can be asked about both disease and environments.[67]

It is hardly surprising then that many who had worked in the field of environmental epidemiology would turn, at the beginning of the twenty-first century, to the emerging field of toxicogenomics. A field inspired by the human genome project on the one hand and toxicology on the other, toxicogenomics focuses on identifying the underlying genetic factors that determine an individual's susceptibility to certain toxins. The goal is to identify discrete changes in a cell's genomic profile that are attributable to a specific toxic agent.[68] Toxicogenomics might be described as both ecological and modern in its approach. It acknowledges forthrightly the permeability of the body but takes as its focus the fact that some bodies are more permeable than others. While it focuses on issues of environmental contamination, it implicitly privileges individual factors (i.e., genetic makeup) as the critical cause of disease. No doubt the contemporary enthusiasm for toxicogenomics comes in part from the fact that it promises the kinds of individual remedies that have been so successful for modern biomedicine in the past. It also leaves behind the messiness of actual social and environmental arrangements for the constrained comforts of the modern laboratory. Once again, it abstracts the "environment" into a set of specific chemicals and turns the focus back to the interior of the body. Meanwhile the environments outside the laboratory continue to change in countless ways. Complex ecological realities continue to coexist with modernist hopes.



## ECOLOGICAL BODIES AND ENVIRONMENTAL JUSTICE

In the years during and after the McFarland controversy, many laypersons and social activists began to formulate a decidedly different approach to the issue of spatialized disease. In histories of environmentalism, the 1980s are noteworthy not only as the decade in which toxic contamination came to dominate the environmental agenda but also as the period in which hundreds of grassroots groups emerged whose agendas diverged from those of mainstream liberal organizations. Although often described as a "movement," the label "environmental justice" actually encompassed diverse environmental struggles on the part of those who felt themselves disenfranchised by the political and regulatory process. These new activists did not focus on conservation or federal pollution policy. Instead what tied their struggles together was their local focus, their concern with health, and their emphasis on the structural (rather than the individual) causes of disease.

Critical to the success of environmental justice was its ability to mobilize long-standing popular resistance to reigning biomedical models of disease and environment. In its attention to the ecology of bodies and the health effects of pollution, environmental justice drew indirectly on the 1960s environmentalism of Rachel Carson and others. Like Carson, environmental justice advocates insisted on the significance of ongoing but low-level exposures to pesticides over many years. Implicitly they viewed human bodies as porous, as always susceptible to insult and injury. Where Carson had both used and critiqued toxicology (the dominant science of environment and health in the 1950s and 1960s), environmental justice advocates developed a similarly ambivalent relationship to risk factor epidemiology. Although they used epidemiologic evidence to demonstrate the spatial nature of disease, they also critiqued the field's reliance on "race" and "lifestyle" as explanatory factors. Like the McFarland mothers, environmental justice activists rejected explanations of ill health in marginalized communities as the outcome of individual choice, genetic inheritance, or simply chance, insisting instead that illness should be associated with poor environmental quality where it could not be proven otherwise.[69] Activists grounded their claims to a clean environment in civil rights discourse and the legal concept of equal protection. From their perspective, the issues of biomedical causality that dominated discussions of toxicology and epidemiology, however interesting, were always secondary to the fact that modern environments were materially different.

But while it drew from earlier understandings, environmental justice

advocacy also rewrote those understandings in ways particular to the late twentieth century. In the 1960s Carson had argued powerfully that everyone was vulnerable to the modern environment—an argument that was designed to appeal to the suburban and otherwise politically complacent middle-class that was her principal audience. In contrast, environmental justice activists made a point of emphasizing that disease was, in fact, spatialized in certain communities—as well-meaning sanitationists and outright racists had argued all along. But environmental justice advocacy reinterpreted the significance of that fact: rather than the outcome of unhygienic habits and susceptible bodies, the spatialization of disease reflected particular histories of land use, the legacies of racial segregation, and the geographic effects of class. This analysis pointed to the environmental and structural, rather than the individual, causes of disease. Because businesses and government had shown proportionately less concern for the environmental quality of poor and nonwhite communities, and in some cases had actively targeted those communities for polluting activities, disease itself was one outcome of racial and class discrimination.[70]

Environmental justice advocates insisted on the need to redifferentiate modern spaces in public health discourse and to acknowledge that living in one landscape, however modern, could be more far dangerous than living in another. This was contrary to the long-standing claims of public health experts that landscape modernization was itself the key to health. It had been a primary goal of modern public health to render local environments as "space"—clean, sanitary, and therefore irrelevant.[71] Environmental justice emphasized the perpetual failure of that project.

In effect, environmental justice activists reterritorialized disease while reappropriating diseased bodies as indicators of particular landscapes. Bodies themselves became (again) a means for visualizing the unseen and ultimately intimate processes of pollution and environmental rearrangement that certain communities experienced: contaminated groundwater, pesticide-laden fog, polluted air. Like the nineteenth-century settlers and physicians who chronicled their bodies' reactions to north winds and winter fogs, community health activists now tracked diagnoses of cancer, the occurrence of miscarriages, and the rates of asthma among local children—already convinced that their ill health must bear some relation to the places that they occupied. Typically they invoked both modern and ecological models of the body. Activists and community members drew on their own experience with pollution and illness, but they framed their concerns within the languages of modern science: groundwater chemistry, laboratory toxicology, and risk factor epidemiology.[72] In these formulations, afflicted bodies were indictments of both certain environments and a capitalist society that fostered a spatialized inequality.



Ironically, as the movement for environmental justice gained national attention in the 1990s, the struggle in McFarland slipped from political and public view. The waning of overt conflict was not, however, a victory for the methods of modern science and public health. Rather it represented the exhaustion of a community that could not generate continuous and public resistance to the institutionalized view of environment and health. Divisions within the community—between Anglos and Latinos, farmworkers and the middle class, the UFW and the affected families—made it difficult for residents to remain united in their response to the cancers. Politicians who had helped highlight the McFarland situation moved on to other issues, and many of the affected families either moved away or simply wanted to move on from the tragedy of cancer. And although most agency representatives continued to insist that studies had shown McFarland's environment to be "safe," few people in the community felt reassured. Instead even the normal illnesses of childhood had become a perpetual cause for anxiety.[73]

In 1995, four years after the state of California ended its investigations, several current and former residents petitioned the U.S. EPA and the Agency for Toxic Substances and Disease Registry to reopen studies of McFarland's environment, this time framing their request in terms of environmental justice. In the meantime, questions from the press forced the California Department of Health Services to acknowledge publicly that seven new cancer cases had occurred between 1990 and 1996 and that the incidence of childhood cancer in McFarland remained unusually high. Although the EPA had agreed to undertake additional studies of McFarland's environment, the local health department, along with the town's Anglo leaders, were strongly opposed. Within the CDHS opinions were mixed: some argued that interviewing the recent cases might turn up new leads; others maintained that their methods were as unlikely to succeed the second time around as they had been the first. To do anything, this group argued, would only raise false hopes in the community while inviting more public scrutiny. In the end, the skeptics won. The CDHS released a fact sheet stating that science could "not provide an answer."[74] Nonetheless, more than a decade after the discovery of the cancer cluster, suspicions remained and studies continued.

Whatever ambiguities remained in McFarland, the developments there and elsewhere marked the decline of the sanitation paradigm in public

health while exposing the weaknesses of a regulatory system built exclusively on that model. The belief in sanitation has always hinged on the overly simple belief that the environment could be made, once and for all, into a passive space. Modernist discourses of sanitation and health had generated the expectation of a benign and controllable landscape and an impervious and autonomous body—expectations that, in the end, modern public health could not deliver. As suspected carcinogens initially applied to crops turned up in air, fog, soil, water, and, eventually, human bodies, it became obvious that health and environmental experts could neither sanitize nor materially contain the new contaminants. Even modern places were not the same, and they were certainly not under anyone's "control."[75]

By the 1980s the supposed distance between bodies and environments that had helped underwrite the project of modernization had become increasingly difficult to sustain in the face of ongoing pollution and unexplained illness. As both science and experience revealed a more complicated and interconnected environment, experts could not deny outright its potential to affect health—even when their own methods failed to reveal any link between environmental conditions and disease. In fact, Proposition 65—California's "right-to-know" legislation—took as its starting point the fact that there are different ways of interpreting chronic disease and the risks posed by toxic chemicals, and therefore the public required information with which to make their own decisions. Even some experts now openly acknowledged the limits of their traditional approach to these issues. "I'd hate to think that anybody is getting the impression that we're giving the environment in McFarland a clean bill of health," one researcher ruefully remarked at the close of the state's investigation.[76] Modern understandings of disease could not encompass the experience of McFarland.

Yet modern understandings of health and environment did not disappear. It would be more accurate to say that they were recalibrated to the new realities. The enthusiasm for toxicogenomics was a case in point. While acknowledging the permeability of the body, it also followed the laboratory paradigm, reduced the environment to a set of discrete toxins, and took as its focus the differential susceptibility of certain bodies. Moreover, it was not only experts who continued to invoke modern understandings. McFarland's residents constructed their relationship to the environment in modern as well as other-than-modern ways. "Modern" in the sense that they sought an unobtainable purity, a landscape and a body free from disease-causing contaminants and pathogens; "other-than-modern" in the



sense that they believed their bodies to be in constant interaction with, and deeply dependent on, the larger environment.

Although simple dichotomies fail to capture the history, it is still true that there were significantly different ways of interpreting the relationship between health and environment in McFarland. To assert a cancer "cluster" in the late twentieth century was to articulate an understanding of the relationship between bodies and environments, humans and nature, that insisted on the relevance of local ecologies. Those who pushed for the recognition and investigation of clusters assumed that local environments had an ongoing effect on health that biomedical science too often failed to reveal and that government institutions were unwilling to fully investigate. They asserted the relevance of sick bodies to understanding the larger environment and the changes it was undergoing. Whether they knew it or not, they were heirs of both Thomas Logan and Rachel Carson. Their opponents, meanwhile, marshaled the modern notion of an independent and self-contained body, insisting, among other things, that a lifetime of pesticide exposures had had no effect on their physical selves. As Michelle Murphy has argued, at any one time, there may exist "different ways of being a body in the world."[77] Certainly that was true in the Central Valley at the end of the twentieth century. But as the residents of McFarland came to realize, only certain understandings have the explicit backing of the state.

It is not surprising that those whose economic and social interests depended on the continuing use of chemicals have a significant stake in asserting the uncertainty or the irrelevance of any connections between environment and health. For those interests, the modern model works well. Yet while economic interests were part of the McFarland story, it was not agribusiness that produced epidemiologic studies or adopted a standards-based regulatory regime. Epistemology is intertwined with, but not necessarily determined by, politics—that would be too simple of a reading. Whatever claims growers and politicians might want to make about health, those claims could only be legitimated by the work of disinterested scientists and government experts who had some claim to neutrality and specialized knowledge. But however much experts might want to take into account the environmental causes of disease (and many did), they also remained professionally vested in the modern model.[78] Science and regulation are themselves products of both culture and history. Culture shapes how scientists and laypeople alike classify and think about "disease" and the "environment," and the history of knowledge production shapes both regulatory structures and contemporary scien-

tific inquiry. It is worth remembering that the basic strategies and assumptions of modern public health were formed in the early twentieth century, when germ theory enjoyed its greatest authority. When new kinds of knowledge—about the ability of the environment to harbor pathogens, about the mobility of chemicals, about the sensitivity of bodies to repeated environmental exposures—challenged modern understandings that insisted on the separation of human beings from nature, it remained difficult if not impossible for those in public health to relinquish, perhaps understandably so, a model that had underwritten the major successes of their field as well as their own professional training. At some point, being "scientific" had come to mean trusting to a specific way of conceptualizing the relationship between bodies and their environments—even though many experts admitted that their methods were woefully inadequate. And so public health experts continued to reconcile complex environmental realities with reductionist methods. That, after all, had worked for them before. Laypeople, meanwhile, were far more willing to abandon the modern model when it failed to explain their experience.

What remains is the tension between modern and ecological ideas of health. To cast that tension as simply a conflict between rationality and irrationality, or between honesty and deceit, is to vastly oversimplify the situation and to ignore a long history of environmental health concerns. And though that tension remained submerged in McFarland in the late 1990s, it was most likely only a matter of time before it reemerged in some form. In fact, more than twenty years after the discovery of the cluster, residents still expressed concern about the environment, while health officials remained sensitive about their role in the McFarland investigations and wary of outsiders who wanted to return to the topic of the cancers.[79] Modernist ideas of bodies and environments remained in place, but their instability was now an open secret.

# Conclusion

The people who have inhabited California have reshaped the landscape in countless ways. The evidence of human-induced change is everywhere; indeed, it is overwhelming. The Central Valley, like all of North America, is now a complicated mixture of human and nonhuman elements, a hybrid landscape: aquifers and aqueducts, soils and chemicals, native plants and commercial crops. But change did not occur in only one direction. As people have shaped the landscape, the landscape has shaped the bodies of its inhabitants. To the extent that health is dependent on the water that people drink, the food that they eat, the air that they breathe, and the organisms that they live alongside, human beings are not materially separable from their environments. Even as the processes of capitalism and the mediations of technology have allowed Americans to become ever more physically and intellectually alienated from their local ecologies, even the most privileged have never fully escaped or superseded them. Persistent concerns about environmental illness mark that fact.

If modernity is, as Bruno Latour suggests, a story we have told ourselves about the separation of human beings from nature, then the history of health is one more place where that story is undermined. It is not simply that what we think of as "nature" is really a complex mixture of nature and culture; what we call "human" is similarly mixed. Not only have humans mixed their labor with nature to create hybrid landscapes; nature—already a mixture of human and nonhuman elements—has intermixed with human bodies, without anyone's consent or control, and often without anyone's knowledge. The malaria plasmodium came to California in the bodies of English trappers who did not realize they

carried it, found a home among California's anopheline mosquitoes, and eventually entered into the bodies of unsuspecting American immigrants, who then propagated the parasite through their agricultural practices. Farmers sprayed their trees with chemicals, which clung to branches and leaves, only to be transformed by the local climate into deadly toxins, which then entered the bodies of workers, shifting the balance of biological chemicals, making bodies tremble and sweat, and sometimes killing them. Similar if less acute changes have occurred in bodies across North America. In the mid-1980s, as the McFarland controversy was unfolding, a study conducted by the U.S. EPA found measurable levels of chemicals in all adults tested in the United States. Most people would no doubt be surprised and disturbed to learn that they have measurable amounts of chlorobenzene, benzene, ethyl benzene, toluene, and polychlorinated biphenols in their fatty tissues.[1] Although the significance of these transactions can be debated, the material connections between bodies and environments to which they attest are undeniable. Ironically, it has often been in the most industrialized landscapes—those landscapes that are typically taken as symbolic of the human alienation from nature—that these connections become most clear. As humans have industrialized the land, the land has, in turn, industrialized them. Neither the realm of nature nor the realm of the human remains pure.

Nineteenth-century medicine seems strange to contemporary readers in part because it made the intermixture of bodies and environments explicit. Admittedly that is also the source of my own attraction to it. Health and medicine remained realms of knowledge in which the modern separation between humans and nature was by no means complete. Both lay and professional understandings held bodies to be permeable. People worried openly about thick fogs, swampy ground, and the effects of mining deposits. Long before the advent of modern ecology, they understood themselves as organisms that were connected to their environment in a multitude of ways. Medical practitioners diagnosed landscapes as well as bodies, reading health from the thermometer, the rain gauge, the timing of fish runs. In that world, health was not a quality that individual bodies possessed or lacked but a state that emerged when a given body was in harmony with a particular landscape.

Although nineteenth-century medicine acknowledged the critical role of the environment, the desire to separate the environment from health and disease was already present. Ecological understandings of health always existed in tension with the desire to transform the land. Germ theory would help resolve that tension in favor of modernization. If early-



twentieth-century public health professionals were overly zealous in their pursuit of germs, it was in part because the new theories served many needs. The advent of germ theory and "modern" medicine coalesced with a growing desire to downplay the environment's role in health, furthering the intellectual separation of human beings from the rest of nature. The healthy body was now a pure body, one that had not been penetrated by pathogens or parasites. The avoidance of these bodily contaminants depended on proper hygiene and sanitation, which supposedly worked to neutralize the surrounding environment: the isolation of wastes, the destruction of insects, the eradication of dirt. Once properly sanitized, the environment could then be ignored, or so some people thought.

When early-twentieth-century public health experts raised the profile of the "germ," they simultaneously described the broader environment as a passive and homogeneous space. The only actors in their story were human beings and certain microscopic pathogens. The ability to produce health now lay with the doctor on the one hand and the individual on the other—an individual who was conceptualized as an autonomous and effective actor who was now urged to rid her house of flies, wash her hands, eat right, and exercise regularly. Changes in the nonhuman environment were no longer something with which doctors or patients need concern themselves. Environmental concerns could thus be left to others—engineers, entomologists, hydrologists, agronomists. The modern construction of the body as a discrete and bounded entity encouraged the isolation of medical from environmental concerns and enabled the further specialization of professionals.

But that isolation has always been somewhat tenuous. In fact, the environment's role in disease could be professionally marginalized, but it could not be denied. Within medicine and public health, environmental concerns continued to find a home in particular subspecialties—including those of tropical medicine, disease ecology, occupational health, sanitary engineering, and modern epidemiology. Medical discourse is itself multifaceted, and some specialties have attended to the environment's influence on disease even when the most dominant specialties have not. But perhaps more important, outside of medicine the decline of Hippocratic ideas was much more gradual and incomplete, and the distinction between environmental and health concerns has often blurred.[2] Even while individuals adopted many of the tenets of a professionalized medical discourse and often deferred to experts, those understandings never fully encompassed individuals' experience of dis-

ease or place, nor have they necessarily erased older understandings. As evidence emerged in the postwar period that environmental change was affecting health, modern assumptions about the environment's irrelevance were repeatedly undermined, and the arrival of sanitary modernity was again deferred.

The notion of the body that has underwritten environmental activism since the 1960s is an uneasy combination of these preceding configurations. It juxtaposes an awareness of the body's permeability and susceptibility to environmental change with the modernist desire for bodily purity. In the early twenty-first century, the ecological body is both dependent on its environmental context and exceedingly vulnerable to contaminants. Because the ecological model of health succeeded the modern construction of the body, it seemed, in some ways, radically new. But, like their nineteenth-century predecessors, those who mobilized an ecological construction of the body saw pathology in landscapes as well as individuals; they viewed bodies as exceedingly porous and vulnerable; and they understood both health and disease as the outcome of many interacting factors. From this perspective, it is the earlier erasure of the environment's role in disease that requires explanation.

Implicit in these different constructions of the body, ecological and modern, have been differing conceptions of the environment and, at root, different ideas about agency. Ideas of bodies and environments, humans and nature, are necessarily intertwined. When nineteenth-century settlers understood their bodies as porous, they also understood the land as a set of unique ecologies, each of which had to be closely studied for its health effects. Disease was not located in a single and discrete pathogenic agent; rather, it was distributed among a host of factors, no one of which could be considered in isolation from the rest. The corollary was that human agency with respect to health was understood as far more constrained and partial. In this world, doctors were necessarily environmental scientists, and the contributions of physicians vis-à-vis nature in the process of healing were always ambiguous.

In retrospect, it may seem only logical that a society based on radical and incessant changes to the landscape would not long sustain an ecological view of the body. Nevertheless, such a view has persisted, even if it has not been the dominant understanding; and such a view has emerged in certain places and moments as the basis for advocating certain environmental actions while proscribing others. Most obviously, much of the modern environmental movement emerged from the experience of health and disease in specific postwar landscapes, like those of



farmworkers in the Central Valley. While market capitalism and industrial technology have increasingly distanced Americans from their environments, their experience and understanding of health still, at certain moments, connects them to the land. No matter how invested someone may be in the processes of capitalist expansion, questions of health can force a reconsideration—as when nineteenth-century boosters warned prospective immigrants to avoid the Central Valley, or successful and otherwise modern farmers began to reconsider their use of pesticides in the wake of a family experience with cancer. Such instances suggest that, at the end of the twentieth century, human alienation from the landscape, even the highly industrialized landscape of the Central Valley, remained incomplete. All this is not to say that understandings of health and environment are independent of the social and economic contexts in which they arise; clearly they are not. But neither are they fully determined by those contexts. They must also incorporate the lived experience of illness and the often recalcitrant materiality of the nonhuman world.[3]

In a world where outright resistance to the processes of unrestrained capitalism has become incredibly difficult to sustain, concerns about illness and its relationship to an industrialized landscape provide an important means for galvanizing different kinds of people to question the trajectory of their own modernization. Political battles over health and understandings of the body in the Central Valley have, for good reason, also been battles over space. Although both postwar environmentalism and contemporary environmental justice have many social and political sources, they also find their basis in an ecological understanding of the body and an environmental understanding of health. Concerns about environmental health often cross lines of class and race, as well as the boundaries of continents and nations. Whether in the late nineteenth century or the late twentieth, debates over disease have also been arguments about how people should live in the landscape, what shape that landscape should take, and how it should be understood.[4] As Henri Lefebvre pointed out some time ago, for those that want to forge different understandings of space and nature, the reappropriation of the body and its conceptualization may be the first critical step.[5]

Concerns about environment and health remain, in the Central Valley and elsewhere. The health effects of pesticide use among both farmworkers and the public constitute an ongoing regulatory debate and, for many, a perpetual source of anxiety. The valley itself has generated a plethora of local environmental justice struggles. In 1989 the California Rural Assistance League, a group that had lobbied for farmworker rights

for more than two decades, formed the Center on Race, Poverty, and the Environment to address the links between environment and health in California's poor and minority communities, and they immediately opened an office in the valley. In 1996 a coalition of cancer and environmental groups formed Californians for Pesticide Reform to lobby for bans on highly toxic pesticides and stricter regulations. In addition, air pollution from sources other than pesticides has emerged as a major health issue in the San Joaquin Valley, which now has one of the highest rates of asthma in the nation. Access to high-quality, uncontaminated drinking water continues to be an issue, a subject of both ongoing litigation and legislation. Like the harsh realities of farm labor in the region, issues of contamination and environmental health have helped recast the image of modern farming in the minds of most outsiders. By the early twenty-first century, the contradictions embedded in the landscape of rural California have become readily apparent: immense productivity and scathing poverty, perfect fruit and toxic pesticides, beautiful landscapes and the fear of cancer.

The history of health and environment as I have told it is not a linear story. It does not conform to either the progressive narrative of medical discovery or the declensionist story of relentless scientific reductionism. There have been both discoveries and reductionism, as there will continue to be. There is no single "right" way to conceptualize human and nonhuman natures, though there are better and worse ways. The environmentalist demand for absolute purity was itself an outgrowth of sanitary modernity—and equally unobtainable, as its critics are quick to point out. But if purity is unobtainable, so, too, is specific etiology. The emphasis on toxicity testing and genetic profiling offers scant hope for finally understanding how complex and ever-changing environments affect the health of their occupants and even less hope for managing those relationships. The question then is, what to do? How do we want to think about health, disease, and environment, and what kinds of practices make the most sense, both socially and biologically?[6] I am not advocating a return to medical topography or the miasma theory, yet it is worth questioning why so much of contemporary biomedicine is divorced from any study of the larger environment and why individual solutions to disease such as improving one's diet are quickly institutionalized while other, more difficult social and environmental questions are not even discussed. Ultimately we cannot escape the environments in which we live, but it should be possible to foster a science and regulatory structure that strives to make visible the density of that connection. In a



cultural moment marked by seemingly unrestrained technological exuberance, recalling and rethinking our physical natures and biological dependence has never been more necessary. This book is a contribution toward that rethinking and part of an ongoing conversation about how best to understand the relationship between our own species and the larger world.

# Notes

## ABBREVIATIONS

| | |
|---|---|
| *BC* | *Bakersfield Californian* |
| BL | Bancroft Library |
| BSE | Bureau of Sanitary Engineering |
| CDA | California Department of Agriculture |
| CDHS | California Department of Health Services |
| CDPH | California Department of Public Health |
| CSA | California State Archives |
| CSBH | California State Board of Health |
| *CSJM* | *California State Journal of Medicine* |
| CSL | California State Library |
| *JAMA* | *Journal of the American Medical Association* |
| KCDPH | Kern County Department of Public Health |
| *LAT* | *Los Angeles Times* |
| *NYT* | *New York Times* |
| *SFC* | *San Francisco Chronicle* |
| *SB* | *Sacramento Bee* |
| SSMI | Sacramento Society for Medical Improvement |
| WRCA | Water Resources Center Archives |

## INTRODUCTION

1. On the social history of the valley, see Walter Goldschmidt, *As You Sow* (New York: Harcourt, Brace, 1947); Cletus Daniel, *Bitter Harvest: A History of California Farmworkers, 1870–1941* (Berkeley: University of California Press, 1981); Devra Weber, *Dark Sweat, White Gold: California Farm Workers, Cotton, and the New Deal* (Berkeley: University of California Press, 1996); Sucheng Chan, *This Bittersweet Soil: The Chinese in California Agriculture, 1869–1910* (Berkeley: University of California Press, 1986); Steven Stoll, *The Fruits of Natural Advantage: Making the Industrial Countryside in California* (Berkeley: University of California Press, 1998); Carey McWilliams, *Factories in the Field: The Story of Migratory Farm Labor in California* (Boston: Little, Brown, 1939); Don Mitchell, *The Lie of the Land: Migrant Workers and the California Landscape* (Minneapolis: University of Minnesota Press, 1996); Linda C. Majka and Theo J. Majka, *Farm Workers, Agribusiness, and the State* (Philadelphia: Temple University Press, 1982). On environmental history, see Donald J. Pisani, *From the Family Farm to Agribusiness: The Irrigation Crusade in California and the West, 1850–1931* (Berkeley: University of California Press, 1984); Robert Kelley, *Battling the Inland Sea: American Political Culture, Public Policy, and the Sacramento Valley, 1850–1986* (Berkeley: University of California Press, 1989); Raymond Dasmann, *The Destruction of California* (New York: Collier Books, 1966); Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West* (New York: Pantheon, 1985); William L. Preston, *Vanishing Landscapes: Land and Life in the Tulare Lake Basin* (Berkeley: University of California Press, 1981); David Igler, *Industrial Cowboys: Miller & Lux and the Transformation of the Far West, 1850–1920* (Berkeley: University of California Press, 2001). For an interesting exception to this literature on the valley, see Ian Tyrell, *True Gardens of the Gods: Californian-Australian Environmental Reform, 1860–1930* (Berkeley: University of California Press, 1999). For a popular account of the valley that also resists the narrative of alienation, see Stephen Johnson, Robert Dawson, and Gerald Haslam, *The Great Central Valley: California's Heartland* (Berkeley: University of California Press, 1993).

2. Worster, *Rivers of Empire*, 5.

3. Conevery Bolton Valenčius, *The Health of the Country: How American Settlers Understood Themselves and Their Land* (New York: Basic Books, 2002), 143. Valenčius's is the only full-length work to address the cultural connection between health and environment. For a collection of recent essays, see Gregg Mitman, Michele Murphy, and Christopher Sellers, eds., *Landscapes of Exposure: Knowledge and Illness in Modern Environments*, *Osiris* 19 (2004). Also see Gregg Mitman, "Hay Fever Holiday: Health, Leisure and Place in Gilded Age America," *Bulletin of the History of Medicine* 77 (2003): 600–635. On eighteenth- and nineteenth-century medical geography, see Nicolaas A. Rupke, ed., *Medical Geography in Historical Perspective*, Supplement No. 20 to *Medical History* (London: Wellcome Trust Center for the History of Medicine, 2000); Frank A. Barrett, "Daniel Drake's Medical Geography," *Social Science of Medicine* 42 (1996): 791–800.

4. For example, Kenneth Thompson, "Insalubrious California: Perception and Reality," *Annals of the Association of American Geographers* 59 (March 1969): 50–64. On "modern medicine," see Richard Harrison Shyrock, *The Development of Modern Medicine: An Interpretation of the Social and Scientific Factors Involved* (London: Victor Gollanz, 1948).



5. For these concerns, see Michelle Murphy, "The 'Elsewhere within Here' and Environmental Illness; or, How to Build Yourself a Body in a Safe Space," *Configurations* 8 (Winter 2000): 87–120; Steve Kroll-Smith and H. Hugh Floyd, *Bodies in Protest: Environmental Illness and the Struggle over Medical Knowledge* (New York: New York University Press, 1997); Phil Brown and Edwin J. Mikkelsen, *No Safe Place: Toxic Waste, Leukemia, and Community Action* (Berkeley: University of California Press, 1990); Morton Lippmann, *Environmental Toxicants: Human Exposures and Their Health Effects* (New York: Wiley-Interscience, 2000).

6. David B. Morris, "Environment: The White Noise of Health," *Literature and Medicine* 15 (Spring 1996): 1–15. Here and in the remainder of the book, for lack of a better term, I follow Morris and others who use the words *modern* and *modernist* to refer to those beliefs and constructions about the body and its diseases that were based on germ theory and which emphasized the separation of bodies from their environmental contexts. In this view, the body is understood as self-contained, illness is strictly an attribute of the body, and the source of illness lies in discrete pathogens or parasites. I am, however, aware of debates over these terms and the argument that *modernist* and *modernism* should be restricted to those artists and art forms associated with a critique of modernization in the late nineteenth and early twentieth century; however, by restricting *modernist* in this way, we are left with no term to describe the ideological and aesthetic positions of those who embraced modernization less critically. I use *modernist* to describe the positions of those in medicine and public health who self-consciously positioned themselves and their ideas as modern, in comparison to the ideas of those who came before. For a good recent discussion of this issue, see Frederick Cooper, *Colonialism in Question: Theory, Knowledge, History* (Berkeley: University of California Press, 2005), 113–52.

7. Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin, 1962); Ralph H. Lutts, "Chemical Fallout: Rachel Carson's *Silent Spring*, Radioactive Fallout and the Environmental Movement," *Environmental Review* 9 (1985): 210–25; Samuel P. Hays, *Beauty, Health, and Permanence: Environmental Politics in the United States, 1955–1985* (New York: Cambridge University Press, 1987). Although historians have recognized that health concerns have had a substantial role in the development of modern environmentalism, the standard histories have given the issue far too little attention. But see Hays and also Adam Rome, *The Bulldozer in the Countryside: Suburban Sprawl and the Rise of American Environmentalism* (New York: Cambridge University Press, 2001).

8. Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002); Bruno Latour, *We Have Never Been Modern*, trans. Catherine Porter (Cambridge, MA: Harvard University Press, 1993); Gregg Mitman, "In Search of Health: Landscape and Disease in American Environmental History," *Environmental History* 10 (April 2005): 184–210. Of course, I rely on the dichotomies as well. As I have suggested, the human/nature distinction is indispensable to history, even as it is limiting. But it may still be possible to the use the tools of history to tell a different kind of story.

9. Exceptions to this include some of the critical work in public health history

that focuses on specific cities: Judith Walzer Leavitt, *The Healthiest City: Milwaukee and the Politics of Health Reform* (Princeton, NJ: Princeton University Press, 1982); Stuart Galishoff, *Newark: The Nation's Unhealthiest City, 1832–1895* (New Brunswick, NJ: Rutgers University Press, 1988). More recent attempts to tell medical histories from specific places include Warwick Anderson, *The Cultivation of Whiteness: Science, Health and Racial Destiny in Australia* (New York: Basic Books, 2003); Martha L. Hildreth and Bruce T. Moran, eds., *Disease and Medical Care in the Mountain West: Essays on Region, History, and Practice* (Reno: University of Nevada Press, 1998).

10. Bruno Latour, *The Pasteurization of France,* trans. Alan Sheridan (Cambridge, MA: Harvard University Press, 1988); Andy Pickering, ed., *Science as Practice and Culture* (Chicago: University of Chicago Press, 1992); Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ: Princeton University Press, 1985).

11. Mitchell, *Rule of Experts,* esp. 19–53; Alan Irwin and Brian Wynne, "Conclusions," in *Misunderstanding Science? The Public Reconstruction of Science and Technology,* ed. Alan Irwin and Brian Wynne (Cambridge: Cambridge University Press, 1996), 218.

12. Joan W. Scott, "The Evidence of Experience," *Critical Inquiry* 18 (Spring 1991): 773–97; Margaret Lock, *Encounters with Aging: Mythologies of Menopause in Japan and North America* (Berkeley: University of California Press, 1993); Annemarie Mol, *The Body Multiple: Ontology in Medical Practice* (Durham, NC: Duke University Press, 2002); Barbara Duden, *The Woman beneath the Skin: A Doctor's Patients in Eighteenth-Century Germany,* trans. Thomas Dunlap (Cambridge, MA: Harvard University Press, 1991).

13. Gregg Mitman, Michelle Murphy, and Christopher Sellers, "Introduction: A Cloud over History," *Osiris* 19 (2004): 9; Valenčius, *Health of the Country,* esp. 53–84; Emily Martin, *Flexible Bodies: The Role of Immunity in American Culture from the Days of Polio to the Age of AIDS* (Boston: Beacon Press, 1994); David B. Morris, *Illness and Culture in the Postmodern Age* (Berkeley: University of California Press, 1998); Thomas Laqueur, *Making Sex: Body and Gender from the Greeks to Freud* (Cambridge, MA: Harvard University Press, 1990); Londa Schiebinger, *Nature's Body: Gender and the Making of Modern Science* (Boston: Beacon Press, 1993); Jonathan Crary and Sanford Kwinter, eds., *Incorporations* (New York: Zone, 1992). As several of these authors suggest, the ability to begin to see the modern body as a historical creation may be because our own conceptions of the body are again changing in fundamental ways. The discourse of immune systems, the interest in alternative therapies, the availability of artificial reproduction, the development of artificial intelligence, developments in modern biology, the awareness of environmental disease—all these are signs that the "modern" body is being remade and that the "zoocentric" model is giving way. See especially Dorion Sagan, "Metametazoa: Biology and Multiplicity," in Crary and Kwinter, *Incorporations,* 362–85.

14. On germ theory, see Andrew Cunningham and Perry Williams, eds., *The Laboratory Revolution in Medicine* (Cambridge: Cambridge University Press, 1992); Michael Worboys, *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865–1900* (Cambridge: Cambridge University Press, 2000); Margaret Pelling, "Contagion/Germ Theory/Specificity," in *Companion Encyclopedia of the History of Medicine,* ed. W.F. Bynum and Roy Porter (New York: Routledge, 1993), 309–34; Nancy Tomes and John Harley Warner, eds., "Introduction to Special Issue on Rethinking the Germ Theory of Disease: Comparative Perspectives," *Journal of the History of Medicine and the Allied Sciences* 52 (January 1997): 7–16.



15. On the construction of race and the colonial project, see Matthew Frye Jacobsen, *Whiteness of a Different Color: European Immigrants and the Alchemy of Race* (Cambridge, MA: Harvard University Press, 1998); Anderson, *Cultivation of Whiteness;* Mark Harrison, *Climates and Constitutions: Health, Race, Environment, and British Imperialism in India, 1600–1850* (New York: Oxford University Press, 1999); David N. Livingstone, "Human Acclimatization: Perspectives on a Contested Field of Inquiry in Science, Medicine and Geography," *History of Science* 25 (1987): 359–94; John Comaroff and Jean Comaroff, "Medicine, Colonialism, and the Black Body," in *Ethnography and the Historical Imagination* (Boulder: Westview Press, 1993), 215–34; Dane Kennedy, "The Perils of the Midday Sun: Climatic Anxieties in the Colonial Tropics," in *Imperialism and the Natural World,* ed. John M. MacKenzie (Manchester: University of Manchester Press, 1990), 118–40. On race in nineteenth-century California, see Tomás Almaguer, *Racial Fault Lines: The Historical Origins of White Supremacy in California* (Berkeley: University of California Press, 1994); Susan Lee Johnson, *Roaring Camp: The Social World of the California Gold Rush* (New York: Norton, 2000). A relevant reading of race and whiteness in a different colonial context is Ann Stoler, "Sexual Affronts and Racial Frontiers: European Identities and the Cultural Politics of Exclusion in Colonial Southeast Asia," *Comparative Studies in Society and History* 34 (July 1992): 514–51.

16. These correlations would lie at the root of the environmental justice movement as it emerged in California and elsewhere in the 1980s. I discuss this in chapter 5, but see also Robert D. Bullard, *Dumping in Dixie: Race, Class, and Environmental Quality,* 3d ed. (Boulder: Westview Press, 2000); David E. Camacho, ed., *Environmental Injustices, Political Struggles: Race, Class, and the Environment* (Durham, NC: Duke University Press, 1998).

17. See also Anderson, *Cultivation of Whiteness;* Nayan Shah, *Contagious Divides: Epidemics and Race in San Francisco's Chinatown* (Berkeley: University of California Press, 2001).

## 1. BODY AND ENVIRONMENT IN AN ERA OF COLONIZATION

1. Alfred W. Crosby, "Virgin Soil Epidemics as a Factor in the Aboriginal Depopulation in America," *William and Mary Quarterly,* 3d ser., 33 (April 1976): 289–99; Alfred W. Crosby, *Ecological Imperialism: The Biological Expansion of Europe, 900–1900* (Cambridge: Cambridge University Press, 1986). On disease and culture, see Alan Bewell, *Romanticism and Colonial Disease* (Baltimore: Johns Hopkins University Press, 1999); David S. Barnes, *The Making of a Social Disease: Tuberculosis in Nineteenth-Century France* (Berkeley: University of California Press, 1995).

2. The most striking example of this is Jared Diamond, *Guns, Germs, and Steel: The Fates of Human Societies* (New York: Norton, 1997). It is perhaps not

coincidental that the emphasis on the role of disease in enabling European colonization in North America came to prominence in the 1970s, in the wake of Vietnam. At that point, the explanation of superior technology no longer seemed adequate in itself, and, moreover, Americans had lost their appetite for their history of colonial violence. See also Joyce Chaplin, *Subject Matter: Technology, the Body, and Science on the Anglo-American Frontier, 1500–1676* (Cambridge, MA: Harvard University Press, 2001).

3. Valenčius, *Health of the Country.* See also Mitman, "Hay Fever Holiday."

4. Virgil J. Vogel, *American Indian Medicine* (Norman: University of Oklahoma Press, 1970), 83; Doyce B. Nunis Jr., "Medicine in Spanish California," *Southern California Quarterly* 76 (1994): 31–58. For the possibility that diseases preceded colonization, see William L. Preston, Jon M. Erlandson, and Kevin Bartoy, "Protohistoric California: Paradise or Pandemic?" *Proceedings of the Society for California Archaeology* 9 (1996): 304–9; William L. Preston, "Serpent in Eden: Dispersal of Foreign Diseases into Pre-Mission California," *Journal of California and Great Basin Anthropology* 18 (1996): 2–37.

5. Maynard Geiger and Clement W. Meighan, *As the Padres Saw Them: California Indian Life and Customs as Reported by the Franciscan Missionaries, 1813–1815* (Santa Barbara, CA: Santa Barbara Mission Archive Library, 1976); Sherburne F. Cook, *The Conflict between the California Indian and White Civilization* (Berkeley: University of California Press, 1943); Ralph L. Beals Jr. and Joseph A. Hester, eds., *California Indians* (New York: Garland Publishing, 1974), 1:86–88; Cook's estimates in Sherburne F. Cook, "Historical Demography," in *Handbook of North American Indians,* vol. 2, *California,* ed. Robert F. Heizer (Washington, DC: Smithsonian Institution Press, 1978), 91–98; Edward D. Castillo, "The Impact of Euro-American Exploration and Settlement," in Heizer, *Handbook of North American Indians,* 2:99–127.

6. Charles N. Rudkin, ed., *The First French Expedition to California: Lapérouse in 1768* (Los Angeles: G. Dawson, 1959); Nunis, "Medicine in Spanish California."

7. Sherburne F. Cook, "The Monterey Surgeons during the Spanish Period in California," *Bulletin of the History of Medicine* 5 (1937): 43–72; José Benites, "California's First Medical Survey: Report of Surgeon-General José Benites," ed. Sherburne F. Cook, *California and Western Medicine* 45 (October 1931): 352–54; Georg H. von Langsdorff, *Langsdorff's Narrative of the Rezanov Voyage to Nueva California in 1806* (Fairfield, WA: Ye Galleon Press, 1988); Nunis, "Medicine in Spanish California."

8. Sherburne F. Cook, "Smallpox in Spanish and Mexican California, 1770–1845," *Bulletin of the History of Medicine* 7 (1939): 153–91.

9. John Work, *Fur Brigade to the Bonaventura: John Work's California Expedition, 1832–1833, for the Hudson's Bay Company,* ed. Alice Bay Maloney (San Francisco: California Historical Society, 1945), 69–70, 72.

10. Work, *Fur Brigade,* 76, 71; *Kern County Weekly Courier* (Bakersfield), 29 August 1874; Stephen Powers, *Tribes of California* (1877; reprint, Berkeley: University of California Press, 1976), 380; John Work, "Letter of 24 February 1834," *Washington Historical Quarterly* 2 (1908): 163–64.



11. Although the existing anthropological and scholarly literature focuses on the arrival of malaria in the 1830s, Rollin's account, written in 1786, notes the presence of "ephemeral and intermittent fevers" in the spring and autumn, which suggests that malaria might have already been present. Certainly it could have been introduced by the Spanish from the Port of San Blas. However, the cool temperatures on the California coast would have kept malaria from becoming epidemic. Rudkin, *First French Expedition;* Sherburne F. Cook, "The Epidemic of 1830–33 in California and Oregon," *University of California Publications in American Archaeology and Ethnology* 43 (1955): 303–26; Robert Boyd, *The Coming of the Spirit of Pestilence: Introduced Infectious Diseases and Population Decline among Northwest Coast Indians, 1774–1874* (Seattle: University of Washington Press, 1999), 84–115, quote on 84; Harold Farnsworth Gray and Russell E. Fontaine, "A History of Malaria in California," in *Proceedings and Papers of the Twenty-fifth Conference of the California Mosquito Control Association* (Turlock, CA: California Mosquito Control Association, 1957). Little attention has been given to the possibility of influenza as well, though there was a concurrent epidemic of that disease in Britain at the time. See Herbert C. Taylor Jr. and Lester L. Hoaglin Jr., "The 'Intermittent Fever' Epidemic of the 1830's on the Lower Columbia River," *Ethnohistory* 9 (1962): 160–78; Cook, "Historical Demography." It is worth noting that Cook estimated Indian population declines to be still greater in the 1845–55 period, when Indians suffered directly the effects of white violence and settlement.

12. The most obvious reason that white mortality was lower was the use of quinine, although Indian methods of treatment may have exacerbated the illness in some cases. Boyd, *Coming of Pestilence,* 91–92, 99–100.

13. For a general history, see Margaret Humphreys, *Malaria: Poverty, Race, and Public Health in the United States* (Baltimore, MD: Johns Hopkins University Press, 2001). On the nineteenth-century Midwest, see Erwin H. Ackerknecht, *Malaria in the Upper Mississippi Valley, 1760–1900,* Supplement No. 4 to the *Bulletin of the History of Medicine* (1945). On the effect of the disease on eighteenth-century colonists in the Chesapeake, see Darrett B. Rutman and Anita H. Rutman, "Of Agues and Fevers: Malaria in the Early Chesapeake," in *Biological Consequences of European Expansion, 1450–1800,* ed. Kenneth F. Kiple and Stephen V. Beck (1976; reprint, Aldershot: Ashgate, 1997). For a summary of the historical incidence of malaria in the United States, see Ernest Carroll Faust, "Malaria Incidence in North America," in *Malariology: A Comprehensive Survey of All Aspects of This Group of Diseases from a Global Standpoint,* ed. Mark F. Boyd (Philadelphia: W. B. Saunders, 1949), 749–63.

14. A. L. Kroeber, *Handbook of the Indians of California,* Bureau of American Ethnology Bulletin 78 (Washington, DC: Smithsonian Institution, 1925), 361, 513, 851. For contemporary accounts, see U.S. Congress, Senate, *Statistical Report on Sickness and Mortality in the Army of the United States,* 36th Cong., 1st sess., 1860, S. Exec. Doc. No. 52, 242; "Medicine among the Mormons and the Indians of North America," *Pacific Medical and Surgical Journal* 4 (May 1861): 343–47.

15. Work, *Fur Brigade,* 73.

16. Vivian Nutton, "Humoralism," in *Companion Encyclopedia to the History of Medicine*, ed. W. F. Bynum and Roy Porter (New York: Routledge, 1993), 281–91.

17. Senate, *Statistical Report on Sickness and Mortality*, 1860, 238.

18. On environment and the body, see Duden, *Woman beneath the Skin;* Valenčius, *Health of the Country*, esp. 53–84; Anderson, *Cultivation of Whiteness*, 11–40; Trudy Eden, "Food, Assimilation, and the Malleability of the Human Body," in *A Centre of Wonders: The Body in Early America*, ed. Janet Moore Lindman and Michele Lise Tarter (Ithaca, NY: Cornell University Press, 2001), 29–42; Kennedy, "Perils of the Midday Sun," 118–40; Mitman, "Hay Fever Holiday."

19. The Spanish reportedly introduced smallpox vaccination into California in 1817. Robert J. Moes, "Manuel Quijano and Waning Spanish California," *California History* 67 (1988): 78–93; Rosemary Keupper Valle, "Prevention of Smallpox in Alta California during the Franciscan Mission Period (1769–1833)," *California Medicine* 119 (July 1973): 73–77.

20. Erwin H. Ackerknecht, "Anticontagionism between 1821 and 1867," *Bulletin of the History of Medicine* 22 (1954): 562–93; Cook, "Smallpox," 156 (quotation from letter of Comandante General Ugarte y Loyola).

21. [Thomas M. Logan et al.], "Report on the Medical Topography and Epidemics of California," *Transactions of the American Medical Association* 16 (1865): 560. On contagion, see Pelling, "Contagion/Germ Theory/Specificity," 309–34; Valenčius, *Health of the Country*, 124–27; Charles Rosenberg, "The Cause of Cholera: Aspects of Etiological Thought in Nineteenth-Century America," *Bulletin of the History of Medicine* 34 (1960): 331–54.

22. Charles E. Rosenberg, "Body and Mind in Nineteenth-Century Medicine: Some Clinical Origins of the Neurosis Concept," in *Explaining Epidemics and Other Studies in the History of Medicine* (New York: Cambridge University Press, 1992), 77. "Climatological relations" from Lorin Blodget, *Climatology of the United States, and of the Temperate Latitudes of the North American Continent* (Philadelphia: J. B. Lippincott, 1857), 456.

23. Thomas M. Logan, *Medical History of the Year 1868, in California* (Sacramento: Sacramento Society for Medical Improvement, 1868), 12; F. W. Hatch, "Report on the Epidemics of California in 1868," *Transactions of the American Medical Association* 20 (1869): 527. Also see E. Malcolm Morse, "Something about the Small-Pox Epidemic," *California Medical Gazette* 1 (January 1869): 130–31.

24. Clarence J. Glacken, *Traces on the Rhodian Shore: Nature and Culture in Western Thought from Ancient Times to the End of the Eighteenth Century* (Berkeley: University of California Press, 1967), 551–622; Rupke, *Medical Geography in Historical Perspective.*

25. Both the British and the American armies began systematizing troop mortality and climate data in the 1830s. See Philip D. Curtin, *Death by Migration: Europe's Encounter with the Tropical World in the Nineteenth Century* (Cambridge: Cambridge University Press, 1989), 1–3; James H. Cassedy, *Medicine and American Growth, 1800–1860* (Madison: University of Wisconsin Press, 1986), 45–46. On tropics, see Nancy Stepan, *Picturing Tropical Nature* (Ithaca, NY: Cornell University Press, 2001); David Arnold, ed., *Warm Climates and Western Medicine: The Emergence of Tropical Medicine, 1500–1900* (Amsterdam: Rodopi, 1996); James Lind, *An Essay on Diseases Incidental to Europeans in Hot Climates, with the Method of Preventing Their Fatal Consequences*, 1st Amer. ed. (Philadelphia: W. Duane, 1811); James Johnson and James Ranald Martin, *The Influence of Tropical Climates on European Constitutions*, 6th ed. (New York: Samuel S. and William Wood, 1846).



26. Johnson and Martin, *Influence of Tropical Climates*, 608.

27. M. Nicolson, "Alexander von Humboldt, Humboldtian Science and the Origins of the Study of Vegetation," *History of Science* 25 (1987): 167–94; Nicolaas A. Rupke, "Humboldtian Medicine," *Medical History* 40 (July 1996): 293–310.

28. On these debates, see Livingstone, "Human Acclimatization."

29. Johnson and Martin, *Influence of Tropical Climates*, 14.

30. Stoler, "Sexual Affronts and Racial Frontiers"; Jacobsen, *Whiteness of a Different Color;* Livingstone, "Human Acclimatization." For a representative primary source, see Charles Pickering, *The Races of Man: And Their Geographical Distribution* (London: John Chapman, 1849).

31. Karen Ordahl Kupperman, "Fear of Hot Climates in the Anglo-American Colonial Experience," *William and Mary Quarterly* 41 (1984): 213–40; Chaplin, *Subject Matter.*

32. Thomas Jefferson, *Notes on the State of Virginia*, ed. William Peden (Chapel Hill: University of North Carolina Press, 1954); Gilbert Chinard, "Eighteenth-Century Theories on America as Human Habitat," *Proceedings of the American Philosophical Society* 91 (February 1947): 27–57; Kupperman, "Fear of Hot Climates," 213–40. On temperate climates and "civilization," see Glacken, *Traces on the Rhodian Shore*, 537–50.

33. Chaplin, *Subject Matter.*

34. Reginald Horsman, *Race and Manifest Destiny: The Origins of American Racial Anglo-Saxonism* (Cambridge, MA: Harvard University Press, 1981); Ackerknecht, *Malaria in the Upper Mississippi Valley*, 16, 19; Blodget, *Climatology*, 460.

35. Stepan, *Picturing Tropical Nature*, 38–39; Samuel Forry, *The Climate of the United States and Its Endemic Influences* (New York: J. & H. G. Langley, 1842); Cassedy, *Medicine and American Growth*, 45.

36. Daniel Drake, *A Systematic Treatise Historical, Etiological, and Practical on the Principal Diseases of the Interior Valley of North America as They Appear in the Caucasian, African, Indian, and Esquimaux Varieties of Its Population*, 2 vols. (New York: Burt Franklin, 1850–54); Barrett, "Daniel Drake's Medical Geography"; Otto Juettner, *Daniel Drake and His Followers: Historical and Biographical Sketches* (Cincinnati, OH: Harvey Publishing Company, 1909); James Rodger Fleming, *Meteorology in America, 1800–1870* (Baltimore, MD: Johns Hopkins University Press, 1990), 75–88, 110–115; Blodget, *Climatology.* For physicians' embrace of Blodget, see George W. Lawrence, "Report of the Committee on Climatology, Etc., of Arkansas," *Transactions of the American Medical Association* 23 (1872): 399.

37. On western booster literature, see David M. Wrobel, *Promised Lands: Promotion, Memory, and the Creation of the American West* (Lawrence: University Press of Kansas, 2002); Robert J. Orsi, "Selling the Golden State: A Study of Boosterism in Nineteenth-Century California" (Ph.D. diss., University of Wisconsin–Madison, 1973).

38. Richard Henry Dana, *Two Years before the Mast; a Personal Narrative of Life at Sea* (1842; reprint, Los Angeles: Ward Ritchie Press, 1964), 216; John Marsh, "Unpublished Letters of Dr. Marsh," *Overland Monthly* 15 (February 1890): 213–20; Lansford W. Hastings, *The Emigrant's Guide to Oregon and California* (Cincinnati: George Conclin, 1845), 44. On Marsh treating people for fever and ague, see Gray and Fontaine, "History of Malaria," 23.

39. Fourgeaud quoted in J. B. de C. M. Saunders, *Humboldtian Physicians in California* (Davis: University of California, Davis, 1971), 13. See also the account in chapter 38 of Edwin Bryant, *What I Saw in California—Being a Journal of a Tour of the Emigrant Route and South Pass of the Rocky Mountains across the Continent of North American, the Great Desert Basin, and through California, in 1846 and '47* (1848; reprint, Santa Ana, CA: Fine Arts Press, 1936).

40. Richard B. Rice, William A. Bullough, and Richard J. Orsi, *The Elusive Eden: A New History of California* (Boston: McGraw Hill, 2002), 194.

41. Letter to Julia Ann Baker, 21 December 1853, John W. H. Baker Letters, BL; Bayard Taylor, *Eldorado, or Adventures in the Path of Empire* (New York: Alfred A. Knopf, 1949), 165; George F. Kent, "Life in California in 1849, as Described in the 'Journal' of George F. Kent," ed. John Walton Caughey, *California Historical Society Quarterly* 20 (March 1941): 26–46, 36; Thomas Kerr, "An Irishman in the Gold Rush: The Journal of Thomas Kerr," ed. Charles L. Camp, *California Historical Society Quarterly* 8 (June 1929): 180; William M'Collum, *California as I Saw It* (1850; reprint, Los Gatos, CA: Talisman Press, 1960), 133. Gunnell cited in Mitchel Roth, "Cholera, Community, and Public Health in Gold Rush Sacramento and San Francisco," *Pacific Historical Review* 66 (1997): 550. Also see J. R. Black, "On the Ultimate Causes of Malarial Disease," *New York Journal of Medicine*, n.s., 14 (March 1854): 200.

42. Kent, "Life in California," 35; Alonzo Delano, *Alonzo Delano's California Correspondence: Being Letters Hitherto Uncollected from the Ottawa (Illinois) Free Trader and the New Orleans True Delta, 1849–1852*, ed. Irving McKee (Sacramento, CA: Sacramento Book Collectors Club, 1952), 54; Bryant, *What I Saw in California;* J. D. B. Stillman, *The Gold Rush Letters of J. D. B. Stillman* (Palo Alto, CA: Lewis Osborne, 1967), 51; Thomas M. Logan, "Letters from California," *New York Journal of Medicine*, n.s. 13 (March 1851), 278–83, quote on 279; Thomas M. Logan, "Letters from California," *New York Journal of Medicine*, n.s., 13 (May 1851): 421–26, quote on 426.

43. *Fourth Biennial Report of the CSBH* (Sacramento, 1877), 38; Henry Gibbons, "Report on Practical Medicine," *Transactions of the Medical Society of the State of California, 1875–76* [6th]: 36.

44. Death rates in the early 1850s among troops were about 18 or 19 per 1,000. By comparison, Philip Curtin estimated the mortality of European troops stationed in the Caribbean in the same period at 47 per 1,000. However, the California statistics may not be comparable simply because men were unlikely to remain long in the region; and if they were ill, they were likely to be transferred home. U.S. Congress, Senate, *Statistical Report on the Sickness and Mortality in the Army of the United States*, 34th Cong., 1st sess., 1856, S. Exec. Doc. No. 96, 449, 452; Curtin, *Death by Migration*, 29.



45. Sacramento statistics appeared in the *California State Medical Journal* 1 (October 1856) and are reproduced in George W. Groh, *Gold Fever: Being a True Account, Both Horrifying and Hilarious, of the Art of Healing (So-Called) during the California Gold Rush* (New York: William Morrow, 1966), 173–74.

46. *Second Biennial Report*, 54–68, quote on 54; "The Insane in California," *Pacific Medical and Surgical Journal* 11 (August 1868): 138; Henry Gibbons, "Insanity and Disease in California," *Pacific Medical and Surgical Journal* 14 (April 1872): 496–503.

47. Thomas M. Logan, "Report on the Medical Topography and Epidemics of California," *Transactions of the American Medical Association* 12 (1859): 91.

48. J. P. Leonard, "Health in California," *Boston Medical and Surgical Journal* 41 (1850): 323–24; J. P. Leonard, "Letter from California," *Boston Medical and Surgical Journal* 41 (1850): 394–99.

49. By the 1870s British colonial policy assumed that lengthy stays in the tropics were to be avoided at all costs. Mark Harrison, "'The Tender Frame of Man': Disease, Climate and Racial Difference in India and the West Indies, 1760–1869," *Bulletin of the History of Medicine* 70 (1996): 68–93.

50. In the 1840s American racial discourse began to emphasize the concept of an "Anglo-Saxon" subdivision of the white race. Horsman, *Race and Manifest Destiny*, 158–228.

51. [Logan et al.], "Report on the Medical Topography" (1865), 549–50; U.S. Congress, *Report of the Joint Special Committee to Investigate Chinese Immigration*, 44th Cong., 2d sess., 1877, S.R. 689, 78. Most Chinese immigrants to California came from South China where malaria had long been endemic; thus many had acquired some immunity to the disease. For contemporary comments on immunity, see Philip King Brown, "The Malarial Fevers of the Sacramento and San Joaquin Valleys," *Transactions of the Medical Society of the State of California, 1899*, 29: 275. On concerns over race in the West, see Wrobel, *Promised Lands*, 157–80.

52. Nott cited in Livingston, "Human Acclimatization," 369. Robert Knox, *The Races of Men: A Fragment* (1850; reprint, Miami, FL: Mnemosyne, 1969), 44 (original emphasis); Louis Agassiz, "Sketch of the Natural Provinces of the Animal World and Their Relation to the Different Types of Man," in *Types of Mankind*, ed. J. C. Nott and George R. Gliddon (Philadelphia: Lippincott, Gambo, 1854), lviii–lxxvi; Horsman, *Race and Manifest Destiny;* George M. Fredrickson, *The Black Image in the White Mind: The Debate on Afro-American Character and Destiny, 1817–1914* (New York: Harper and Row, 1971); Nancy Stepan, "Biological Degeneration: Races and Proper Places," in *Degeneration: The Dark Side of Progress*, ed. J. Edward Chamberlain and Sander L. Gilman (New York: Columbia University Press, 1985), 97–120, esp. 100–101.

53. Hastings quoted in Horsman, *Race and Manifest Destiny*, 211. On the population of European descent in California during the Spanish and Mexican

periods, see Daniel J. Garr, "A Rare and Desolate Land: Population and Race in Hispanic California," *Western Historical Quarterly* 6 (April 1975): 133–48. James Ranald Martin, *The Influence of Tropical Climates on European Constitutions,* 7th ed. (London: John Churchill, 1856), 138.

54. M'Collum, *California as I Saw It,* 88. On argonaut attitudes toward whites in Latin America, see also Brian Roberts, *American Alchemy: The California Gold Rush and Middle-Class Culture* (Chapel Hill: University of North Carolina Press, 2000), 122–24. On European fears of degeneration in hot climates, see Stepan, "Biological Degeneration"; Daniel Pick, *Faces of Degeneration: A European Disorder, c. 1848–1918* (Cambridge: Cambridge University Press, 1989). On degeneration and the western frontier, see Louis S. Warren, "Buffalo Bill Meets Dracula: William F. Cody, Bram Stoker, and the Frontiers of Racial Decay," *American Historical Review* 107 (October 2002): 1124–57. Quote in letter from John Baker to Julia Ann Baker, 20 September 1853, John W. H. Baker Letters, BL.

55. Blodget, *Climatology,* 273–74. As one observer wrote of Fort Yuma in the southern California desert, it had not "received its full share of justice as the hottest military post on the continent of North America, and, perhaps, in the world." Senate, *Report on Sickness and Mortality* (1856), 438.

56. "Pacific Coast Diseases," *California Medical Gazette* 1 (January 1857): 323; *Second Biennial Report,* 18–19.

57. F. W. Hatch, "On the Climate of the Valley of the Sacramento, California," *New York Journal of Medicine,* n.s., 15 (July 1855): 33–34; John S. Griffin, *A Doctor Comes to California: The Diary of John S. Griffin, Assistant Surgeon with Kearny's Dragoons, 1846–1847,* ed. George Walcott Ames Jr. (San Francisco: California Historical Society, 1943), 43; Peter C. Remondino, *Longevity and Climate* (San Francisco: Woodward & Co., [1890]), 34–35.

58. Dr. Henry Gibbons made a similar argument about the Irish in this period. Trying to explain the high rates of consumption among Irish immigrants to California, Gibbons claimed they were subject to illness when removed from a harsh life to one of "ease and indulgence," such as the one they had supposedly found on the West Coast. *Third Biennial Report,* 241. More generally, Horsman, *Race and Manifest Destiny,* 189–207.

59. James Blake, "On the Climate and Diseases of California," *American Journal of the Medical Sciences* 24 (1852): 63; Senate, *Report on Sickness and Mortality* (1856), 442; J. S. Hittel, *Resources of California,* 3d ed. (San Francisco: A. Roman and Co., 1867), 368; Horatio R. Storer, "Female Hygiene," appendix to *First Biennial Report.* Retort to Cole quoted in Guy P. Jones, "Thomas M. Logan, M.D., Organizer of California State Board of Health," *California's Health* 2 (15 March 1945): 132. Alan Bewell cites a similar concern over the vulnerability of white females among the nineteenth-century British in *Romanticism and Colonial Disease,* 280–82. The assumption that white Americans would outbreed others in the West was a common assumption among American expansionists in the period. See Horsman, *Race and Manifest Destiny,* 243.

60. J. H. Stallard, *Female Health and Hygiene on the Pacific Coast* (San Francisco: Bonnard & Daly, 1876), 5; *First Biennial Report,* 6; Charles Nordhoff, *Nordhoff's West Coast California, Oregon, and Hawaii* (London: KPI, 1987), 198–99. On positive effects of climate on fertility, Remondino, *Longevity and Climate,* 20.



61. Charles Loring Brace, *The New West: Or, California in 1867–1868* (New York: G. P. Putnam & Son, 1869), 367–71; Remondino, *Longevity and Climate,* 21. Late-nineteenth-century boosters also frequently published pictures of healthy white babies to substantiate their claims. See, Wrobel, *Promised Lands,* 174.

62. This point has been elegantly developed in Valenčius, *Health of the Country.* On doctor-naturalists, see Nunis, "Medicine in Spanish California."

63. For example, Gibbons, "Practical Medicine," 29; "Climate and Disease," *Pacific Medical and Surgical Journal* 14 (February 1872): 421 (for quote).

64. Richard Harrison Shyrock (*Medical Licensing in America, 1650–1965* [Baltimore, MD: Johns Hopkins University Press, 1967, 31–32]) cites a study in eastern Tennessee that found that only 17 percent of physicians had taken a regular degree. On Logan's background, see J. M. Toner, "Life and Professional Labors of Thomas Muldrup Logan, M.D., of California," *Transactions of the Medical Society of the State of California, 1875–76* [6th]: 136–43; Jones, "Thomas M. Logan"; Henry Harris, *California's Medical Story* (San Francisco: J. W. Stacey, 1932). For Logan's views on the profession, see Thomas M. Logan, *Valedictory Address in Behalf of the Faculty of the Medical Department of the University of California* (San Francisco, 1874). Quote from [Logan et al.], "Report on Medical Topography" (1865), 543.

65. Quote is from "Climate and Disease," 421. Hatch, "Climate of the Valley of the Sacramento"; F. W. Hatch, "Report on Climatology and Diseases of California," *Transactions of the American Medical Association* 23 (1872): 335–67. See also the description of the meteorological interests of Henry Gibbons's brother, William Gibbons, in Harris, *California's Medical Story,* 328.

66. Logan quoted in J. Roy Jones, *Memories, Men and Medicine: A History of Medicine in Sacramento, California* (Sacramento: Sacramento Society for Medical Improvement, 1950), 53–54; *First Biennial Report,* 16–20. Thomas Logan collected the most extensive meteorological data for the city of Sacramento, which were used by contemporary engineers and eventually incorporated into the Smithsonian Institution's meteorological records. See *Annual Report of the California Surveyor-General, 1861–62* (Sacramento, 1862) and Thomas M. Logan, "Contributions to the Physics, Hygiene and Thermology of the Sacramento River," *Pacific Medical and Surgical Journal* 7 (1864): 145–51.

67. Thomas M. Logan, "Contributions to the Medical History of California," *California Medical Gazette* 1 (October 1856): 192–93. In fact, the formation of the California State Board of Health coincided with concerns over the pace of white immigration and the state's relatively slow growth in (white) population. Orsi, "Selling the Golden State," 11–59.

## 2. PLACING HEALTH AND DISEASE

1. *Sixth Biennial Report of the California State Board of Health* (Sacramento, 1880), 31.

2. SSMI, "Minutes," 15 August 1882, 19 August 1884, CSL.

ies on Pesticides," 15 December 1969–1 November 1970, 13–33. See also the statement of Representative Scherle in U.S. House, *OSHA Hearings*, 1344–45; "Mothers Alarmed at DDT Danger," *El Malcriado*, 1–15 August 1969, 3. More recent sociological work has pointed to the fact that the views of hazards are more closely correlated with race and gender than with variables such as income and education. Linda Kalof, Thomas Dietz, Gregory Guagnano, and Paul C. Stern, "Race, Gender and Environmentalism: The Atypical Beliefs of White Men," *Race, Gender and Class* 9 (2002): 112–130.

81. CDPH, "Community Studies on Pesticides," 15 December 1969–1 November 1970, 23. See also the examples in Hazlett, "Voices from the *Spring*"; "Consumer Group Backs Boycott," *El Malcriado* 15 August–15 September 1969, 15; Brown, "United Farm Workers," 194; Ulrich Beck, *Risk Society: Toward a New Modernity*, trans. Mark Ritter (London, 1992), 74. Both the Consumer Federation of America and the National Consumers League endorsed the boycott.

82. The longest interval applied to parathion was subsequently extended for the heaviest applications. The history of these regulations at the federal level is quite complex. In 1972 the EPA convened a special task force on Occupational Exposure to Pesticides to suggest reentry standards, although the committee failed to recommend reentry intervals due to the opposition of agricultural interests. In frustration, some farmworker and environmental groups petitioned OSHA to issue emergency standards, which it did in 1973. Those standards were subsequently challenged by the American Farm Bureau and were overturned on appeal (*Florida Peach Growers v. U.S. Department of Labor* [1974]), which awarded jurisdiction on the issue to the EPA. That was significant, because the EPA's statute required it to take benefits as well as risks into account, whereas the OSHA statute called only for the protection of worker safety. The EPA initially adopted reentry regulations in 1974. These were updated in 1991; however, they remained relatively weak. Wargo, *Our Children's Toxic Legacy*, 256–57, 374 (n. 31, 32); Victoria Elenes, "Farmworker Pesticide Exposures: Interplay of Science and Politics in the History of Regulation (1947–1988)" (Master's thesis, University of Wisconsin–Madison, 1991); Orville E. Paynter, "Worker Reentry Safety: Viewpoint and Program of the Environmental Protection Agency," *Residue Reviews* 62 (1976): 13–20; Robert F. Wasserstrom and Richard Wiles, *Field Duty: U.S. Farmworkers and Pesticide Safety* (Washington, DC. World Resources Institute, 1985), 13–19.

83. David Arnold (*Problem of Nature*, esp. 11) has also remarked on this general shift in Western attitudes.

## 5. CONTESTING THE SPACE OF DISEASE

1. Jennifer Warren, "Mysterious Cancer Clusters Leave Anxiety in Three Towns," *LAT*, 12 July 1992.

2. Celene Krauss, "Challenging Power: Toxic Waste Protests and the Politicization of White, Working-Class Women," in *Community Activism and Feminist Politics: Organizing across Race, Class, and Gender*, ed. Nancy A. Naples (New York: Routledge, 1998), 129–50. The literary critic Lawrence Buell has tracked the emergence of what he terms "toxic discourse" in this decade. See Buell, "Toxic Discourse." Also, Cynthia Deitering, "The Postnatural Novel," in *The Ecocriticism Reader: Landmarks in Literary Ecology*, ed. Cheryll Glotfelty and Harold Fromm (Athens: University of Georgia Press, 1996), 196–203.



3. California Department of Fish and Game, *Pesticides: Their Use and Toxicity*; "Investigators Report Another Fish-Dieoff in Sacramento River," *SFC*, 21 June 1963; "State Fish Warden Reports Death of 10,000 Fish," *SFC*, 1 August 1963; "Fish Poisoned in Yolo County Canals," *SFC*, 2 August 1963; "More Fish Killed Near Yuba City," *SFC*, 13 August 1963; "Another Fish Kill Reported in Yolo County," 31 August 1963; Edward D. Stetson, "Planning a Master Drain for the San Joaquin Valley of California," presentation to the 1963 Annual Meeting of the American Society of Agricultural Engineers, typescript, 17, WRCA; U.S. Federal Water Pollution Control Administration, *Effects of the San Joaquin Master Drain on Water Quality of the San Francisco Bay and Delta* (San Francisco, 1967); Nye, "Visions of Salt," 250–63, 283–84. Elsewhere in the country, testing in the 1950s had revealed that DDT was contaminating some drinking water supplies, and some experts suggested that this might pose long-term health risks (W. C. Hueper, "Cancer Hazards from Natural and Artificial Water Pollutants," in *Conference on Physiological Aspects of Water Quality*, ed. Harry A. Faber and Lena J. Bryson [Washington, DC: U.S. Public Health Service, 1960], 181–94).

4. Joseph A. Cotruvo and Chieh Wu, "Controlling Organics: Why Now?" *Journal of the American Water Works Association* 70 (November 1978): 590–94; Daniel A. Okun, "Drinking Water and Public Health Protection," in *Drinking Water Regulation and Health*, ed. Frederick W. Pontius (New York: John Wiley & Sons, 2003), 3–24. Gurian and Tarr, "First Federal Drinking Water Standards."

5. Gurian and Tarr, "First Federal Drinking Water Standards."

6. More accurately, the Safe Drinking Water Act insisted on the establishment of two sets of standards. One set, the "recommended maximum contaminant levels" (RMCLs, later renamed "maximum contaminant level goals," or MCLGs) were to be based solely on the protection of health and were not enforceable. The second set of goals, the MCLs, were enforceable but could take into account technical feasibility when necessary. William E. Cox, "Evolution of the Safe Drinking Water Act: A Search for Effective Quality Assurance Strategies and Workable Concepts of Federalism," *William and Mary Law and Policy Review* 21 (Winter 1997): 69–165.

7. An MCL was adopted for total trihalomethanes; in addition, a treatment standard was adopted for large public water supplies likely to be polluted by soluble organic compounds (SOCs) of "industrial origin." Opposition led to abandonment of the treatment standard in 1981. Congress took a much more forceful approach in 1986 amendments, mandating the adoption of MCLs for many organics, including several pesticides. Cox, "Evolution of the Safe Drinking Water Act."

8. Wargo, *Our Children's Toxic Legacy*, 147–52; R. G. Butler, G. T. Orlob, and P. H. McGauhey, "Underground Movement of Bacterial and Chemical Pollutants," *Journal of the American Water Works Association* 46 (1954): 97–113; New York State Department of Health, *Bibliography of Organic Pesticide Publi-*

*cations having Relevance to Public Health and Water Pollution Problems* by Patrick R. Dugan, Robert M. Pfister, and Margaret L. Sprague ([Albany?], 1963). On the lack of research, see W. F. Barthel, R. T. Murphy, W. G. Mitchell, and Calvin Corley, "The Fate of Heptachlor in the Soil Following Granular Application to the Surface," *Journal of Agriculture and Food Chemistry* 8 (November–December 1960): 445–47; William E. Stanley and Rolf Eliassen, *Status of Knowledge of Ground Water Contaminants* (Cambridge, MA: Department of Civil and Sanitary Engineering, MIT, 1960). For assumption that pesticides would not reach groundwater, see Mahfouz H. Zaki, Dennis Moran, and David Harris, "Pesticides in Groundwater: The Aldicarb Story in Suffolk County, NY," *American Journal of Public Health* 72 (December 1982): 1391–94. The California study mentioned is California Department of Water Resources, *The Fate of Pesticides Applied to Irrigated Agricultural Land,* Bulletin No. 174–1 (Sacramento, 1968). Craig Colten documents what experts did know about industrial wastes and groundwater contamination in "A Historical Perspective on Industrial Wastes and Groundwater Contamination," *Geographical Review* 81 (April 1991): 215–28; however, most of his examples focus on the underground disposal of wastes.

9. In response to industry pressure, the federal government continued to allow the use of DBCP on pineapples in Hawaii; a complete ban on the use of DBCP in agriculture did not come until 1981. Jean Seligmann and Mark Whitaker, "Industrial Sterility," *Newsweek,* 29 August 1977, 69; M. D. Whorton, R. M. Krauss, S. Marshall, and T. H. Milby, "Infertility in Male Pesticide Workers," *Lancet* 2 (1977): 1259–61; H. Babich and D. L. Davis, "Dibromochloropropane (DBCP): A Review," *Science of the Total Environment* 17 (1981): 207–21; *Federal Register* 42 (9 September 1977): 45536–49; Sharon Frey, "DBCP: A Lesson in Groundwater Management," *UCLA Journal of Environmental Law and Policy* 5 (1985): 81–99. On recommended uses, see A. L. Taylor, "Progress in Chemical Control of Nematodes," in *Plant Pathology: Problems and Progress, 1908–1958,* comp. Charles S. Holton (Madison: University of Wisconsin Press, 1959), 427–34.

10. California Department of Food and Agriculture, "Pesticide Movement to Ground Water: Survey of Ground Water Basins for DBCP, EDB, Simazine and Carbofuron," draft report (Sacramento, 1983).

11. On DBCP, S. A. Peoples, K. T. Maddy, W. Cusick, T. Jackson, C. Cooper, and A. S. Frederickson, "A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues," *Bulletin of Environmental Contamination and Toxicology* 24 (1980): 611–18; David B. Cohen, "Ground Water Contamination by Toxic Substances: A California Assessment," in *Evaluation of Pesticides in Ground Water,* ed. Willa Y. Garner, Richard C. Honeycutt, and Herbert N. Nigg (Washington, DC: American Chemical Society, 1986), 499–529; Helmut Kloos, "1,2-Dibromo-3-Chloropropane (DBCP) and Ethylene Dibromide (EDB) in Well Water in the Fresno/Clovis Metropolitan Area, California," *Archives of Environmental Health* 51 (July–August 1996): 291–99. On pesticides and groundwater generally, Zaki, Moran, and Harris, "Pesticides in Groundwater"; S. Z. Cohen, S. M. Creeger, and C. G. Enfield, "Potential Pesticide Contamination of Groundwater from Agricultural Uses," in *Treatment and Disposal of Pesticide Wastes,* ed. Raymond F. Krueger and James N. Seiber (Washington, DC: American Chemical Society, 1984), 297–326.



12. Council on Environmental Quality, *Environmental Quality: The Eleventh Annual Report, 1980* (Washington, DC: U.S. GPO, 1980), 81–100; U.S. House, Committee on Energy and Commerce, Subcommittee on Health and the Environment and Committee on Interstate and Foreign Commerce, Subcommittee on Transportation and Commerce, *Hazardous Waste and Drinking Water: Joint Hearings,* 96th Cong., 2d sess., 1980; Harold C. Barnett, *Toxic Debts and the Superfund Dilemma* (Chapel Hill: University of North Carolina Press, 1994), 23–24; Michael R. Edelstein, *Contaminated Communities: Coping with Residential Toxic Exposure,* 2d ed. (Boulder: Westview Press, 2004).

13. In addition to the soil fumigants, the chemicals found most frequently in groundwater were aldicarb, atrazine, simazine, pentachlorophenol, maneb, ziram, and thiram. Organophosphates such as parathion—while still widely used—were only rarely found in groundwater, presumably because they usually broke down quickly in water. Kloos, "1,2-Dibromo-3-Chloropropane (DBCP)"; Peoples et al., "Samples of Well Water"; California Water Resources Control Board, *Groundwater Contamination by Pesticides: A California Assessment,* by Yoram J. Litwin, Norman N. Hantzache, and Nancy A. George (Sacramento, 1983); Cohen, "Ground Water Contamination," 503 (for quote); Paul G. Barnett, *Survey of Research on the Impacts of Pesticides on Agricultural Workers and the Rural Environment* (Davis: California Institute for Rural Studies, 1989), 21; Robert B. Gunnison, "Survey of State Wells Finds 57 Pesticides," *SFC,* 17 April 1985; Sharon Begley, Gerald C. Lubenow, and Mark Miller, "Silent Spring Revisited?" *Newsweek,* 14 July 1986; S. Z. Cohen, C. Eiden, and M. N. Lorber, "Monitoring Ground Water for Pesticides," in *Evaluation of Pesticides in Ground Water,* 170–96. The California Assembly passed the Organic Chemical Contamination Act (AB 1803), which mandated that drinking water be tested periodically for forty listed pesticides (Frey, "DBCP," 91). The transnational dimensions of the problem were exacerbated by environmental concerns in the United States because American chemical companies typically exported banned pesticides, such as DBCP, to countries in the developing world (U.S. Senate, Committee on Agriculture, Nutrition, and Forestry, *Circle of Poison: Impact of U.S. Pesticides on Third World Workers,* 102d Cong., 1st sess., 1991).

14. U.S. Geological Survey, *Nitrate and Pesticides in Ground Water in the Eastern San Joaquin Valley, California: Occurrence and Trends,* by Karen R. Burow, Sylvia V. Stork, and Neil M. Dubrovsky, Water-Resources Investigations Report No. 98–4040 (Sacramento, 1998).

15. U.S. Geological Survey, *Regional Assessment of Nonpoint-Source Pesticide Residues in Ground Water, San Joaquin Valley, California,* by Joseph L. Domagalski and Neil M. Dubrovsky, Water-Resources Investigations Report No. 91–4027 (Sacramento, 1991), 5–8; U.S. Geological Survey, *Environmental Setting of the San Joaquin-Tulare Basins, California,* by Jo Ann M. Gronberg et al., Water-Resources Investigations Report No. 97–4205 (Sacramento, 1998), 23–42. The earlier report was U.S. EPA, *Effects of Agricultural Pesticides in the Agricultural Environment, Irrigated Croplands, San Joaquin Valley* (Washington, DC: U.S. GPO, 1972).

16. U.S. Geological Survey, *Ground Water in the Central Valley, California—A Summary Report,* by G. L. Bertoldi, R. H. Johnston, and K. D. Evenson, USGS Professional Paper 1401A (Sacramento, 1991); U.S. Geological Survey, *Environmental Setting,* 23–29. On cross contamination, see California Department of Water Resources, *Water Well Standards: San Joaquin County,* Bulletin No. 74–5 (Sacramento, 1965). Although typically the chemicals present in irrigation water are derived from leaching, sometimes pesticides and herbicides are put directly into irrigation water. This technique, called "chemigation," was introduced in 1980 (Litwin, *Groundwater Contamination by Pesticides,* 109).

17. Frey, "DBCP."

18. U.S. Geological Survey, *Pesticides in the Atmosphere: Distribution, Trends, and Governing Factors,* by Michael S. Majewski and Paul D. Capel, Open-File Report NO. 94–506 (Sacramento, 1995); Lynn R. Goldman et al., "Acute Symptoms in Persons Residing Near a Field Treated with the Soil Fumigants Methyl Bromide and Chloropicrin," *Western Journal of Medicine* 147 (1987): 95–98. "Coincidental exposures" include drift and other "inadvertent" applications (Barnett, *Impact of Pesticides,* 24).

19. Zev Ross and Jonathan Kaplan, *Poisoning the Air: Airborne Pesticides in* California (San Francisco: California Public Interest Research Group and Californians for Pesticide Reform, 1998), 6; D. E. Glotfelty, J. N. Seiber, and L. A. Liljedahl, "Pesticides in Fog," *Nature* 325 (12 February 1987): 602–5; Dwight E. Glotfelty, Michael S. Majewski, and James N. Seiber, "Distribution of Several Organophosphorus Insecticides and Their Oxygen Analogues in a Foggy Atmosphere," *Environmental Science and Technology* 24 (1990): 353–57; J. M. Zabik and J. N. Seiber, "Atmospheric Transport of Organophosphate Pesticides from California's Central Valley to the Sierra Nevada Mountains," *Journal of Environmental Quality* 22 (March 1993): 80–90. For more recent concerns about pesticides and air pollution in the valley, see Sean Gray, Zev Ross, and Bill Walker, *Every Breath You Take: Airborne Pesticides in the San Joaquin Valley* (Washington, DC: Environmental Working Group, 2001), www.ewg.org.

20. In addition, twenty-six pesticides had been made subject to periodic monitoring. Ross and Kaplan, *Poisoning the Air,* 14.

21. Research conducted in the 1980s found that as little as 10 to 15 percent of applied pesticides reached their target, while the remainder moved into air, soil, and water. Marion Moses et al., "Environmental Equity and Pesticide Exposure," *Toxicology and Industrial Health* 9 (1993): 913–59.

22. "McFarland—Star of the San Joaquin," Special Historical Edition of *The McFarland Press,* 17 November 1967, vertical file, Beale Memorial Library, Bakersfield, CA.

23. Johnston and McCalla, *Whither California Agriculture,* chap. 3; Fred Krissman, "California Agribusiness and Mexican Farm Workers (1942–1992): A Bi-National Agricultural System of Production/Reproduction" (Ph.D. diss., University of California, Santa Barbara, 1996), 204. Most of the pesticide usage on grapes (by weight) is accounted for by sulfur, which poses a low hazard. However, grapes also account for significant use of high hazard insecticides, such as methomyl, carbofuran, and formerly dinoseb. William S. Pease et al., *Pesticide Use in California: Strategies for Reducing Environmental Health Impacts* (Berkeley: University of California, California Policy Seminar, 1996).



24. Krissman, "California Agribusiness," 172–90; Fred Krissman, "Cycles of Deepening Poverty in Rural California: The San Joaquin Valley Towns of McFarland and Farmersville," in *The Dynamics of Hired Farm Labour: Constraints and Community Responses,* ed. Jill L. Findeis et al. (Oxon: CABI Publishing, 2002), 183–96.

25. In addition, later surveys found that the community's fetal and infant mortality rates had also increased in the early 1980s. The actual number of cancer cases was always an issue of dispute with community members, who knew of additional cases that were excluded from the tally for various reasons. Ronald B. Taylor, "Cancer Cluster Probe Focuses on Dozen Pesticides," *LAT,* 31 December 1987; "Housing Demand in Cluster High," *BC,* 3 January 1988; Ronald B. Taylor, "Officials Assailed for Slowness in Probing Cancer Clusters," *LAT,* 17 October 1987.

26. "Players in McFarland Case," *BC,* 15 October 1987; California Senate, Toxics and Public Safety Management Committee, *Childhood Cancer Incidences—McFarland* [Hearings], 23 July 1985, McFarland, CA.

27. Kern County Health Department, *Epidemiologic Study of Cancer in Children in McFarland, California, 1985–1986; Phase I; Statistical Considerations, Current Environment,* by Leon M. Hebertson et al. (Bakersfield, CA, 1986]). High concentrations of nitrates can cause methemoglobinemia, or "blue-baby syndrome," in infants. Although nitrates themselves are not carcinogenic, they can act as procarcinogens. For instance, when populations are also exposed to l-proline along with nitrate, the potential for nitrosamine formation is much higher, and recent studies have shown an association between levels of N-nitrosoproline and certain cancers. Overall the evidence linking nitrates in drinking water with cancer has been equivocal (Kenneth P. Cantor, Carl M. Shy, and Clair Chilvers, "Water Pollution," in *Cancer Epidemiology and Prevention,* ed. David Schottenfeld Jr. and Joseph F. Fraumeni [New York: Oxford University Press, 1996], 428–29).

28. Michelle Murphy, "The 'Elsewhere within Here' and Environmental Illness"; Joan C. Martin, "Drugs of Abuse during Pregnancy: Effects upon Offspring Structure and Function," *Signs: Journal of Women and Culture in Society* 2 (Winter 1976): 357–68; Lawrence D. Longo, "Environmental Pollution and Pregnancy: Risks and Uncertainties for the Fetus and Infant," *American Journal of Obstetrics and Gynecology* 137 (15 May 1980): 162–73; Dally, "Thalidomide"; Nancy Weaver and Maria Camposeco, "4th Valley Town Added to Childhood Cancer List," *SB,* 24 September 1989.

29. "Housing Demand in Cluster High."

30. Fran Smith, "Cancer Stalks Town's Children," *San Jose Mercury News,* 30 June 1985.

31. Melosi, *Sanitary City,* 55–56.

32. Neil Pearce, "Traditional Epidemiology, Modern Epidemiology, and Public Health," *American Journal of Public Health* 86 (May 1996): 678–83; Mervyn Susser, "Choosing a Future for Epidemiology: I. Eras and Paradigms," *American Journal of Public Health* 86 (May 1996): 668–73; Nancy Krieger, "Epidemiology and the Web of Causation: Has Anyone Seen the Spider?" *Social Science and Medicine* 39 (1994): 887–903; Mervyn Susser, "Epidemiology Today: 'A Thought-Tormented World,'" *International Journal of Epidemiology* 18 (Sep-

tember 1989): 481–88; Mervyn Susser, "Epidemiology in the United States after World War II: The Evolution of Technique," *Epidemiologic Reviews* 7 (1985): 147–77; Steve Wing, "Limits of Epidemiology," *Medicine and Global Survival* 1 (1994): 74–86. Susser ("Epidemiology after World War II") points out that the focus on multiple factors reflected the rise of both probabilistic thinking and computer technology after World War II. Computers made it increasingly feasible to store and manipulate large data sets and facilitated the analyses of large numbers of variables.

33. John R. Goldsmith and Lester Breslow, "Epidemiological Aspects of Air Pollution," *Journal of the Air Pollution Control Association* 9 (November 1959): 129–32; Raymond Neutra, interview by author, 7 March 2005, Oakland, CA.

34. John Higginson and Calum S. Muir, "The Role of Epidemiology in Elucidating the Importance of Environmental Factors in Human Cancer," *Cancer Detection and Prevention* 1 (1976): 79–105; National Cancer Institute, *Atlas of Cancer Mortality for U.S. Counties: 1950–1969*, by Thomas J. Mason et al. (Bethesda, MD: U.S. Department of Health, Education, and Welfare, 1975); W. J. Blot, "Cancer Mortality in U.S. Counties with Petroleum Industries," *Science* 198 (7 October 1977): 51–53.

35. "Environmental Cancer on the Rise," *Science News*, 5 July 1980; E. M. Whelan, "What Is Environmental Cancer and How Can You Defend against It?" *Vogue*, December 1978; "Cancer and Your Environment," *Harper's Bazaar*, April 1976; "What Causes Cancer?" *Newsweek*, 26 January 1976; Samuel Epstein, *Politics of Cancer* (New York: Anchor, 1979); Proctor, *Cancer Wars*, 57–64.

36. Higginson and Muir, "Role of Epidemiology," 92; E. Boyland, "A Chemist's View of Cancer Prevention," *Proceedings of the Royal Society of Medicine* 60 (1967): 93–99; Clark W. Heath Jr., "Environmental Pollutants and the Epidemiology of Cancer," *Environmental Health Perspectives* 27 (1978): 7–10. On Love Canal, Adeline Levine, *Love Canal: Science, Politics, and People* (Lexington, MA: Lexington Books, 1982). On Woburn, Jonathan Harr, *A Civil Action* (New York: Random House, 1995); Brown and Mikkelsen, *No Safe Place*.

37. California Department of Health Services, *Literature Review on the Toxicological Aspects of DBCP and an Epidemiological Comparison of Patterns of DBCP Drinking Water Contamination with Mortality Rates from Selected Cancers in Fresno County, California 1970–1979*, by Richard J. Jackson et al. (Berkeley, 1982); "Birth Defects Linked to Contamination from Silicon Valley Company," *Seattle Times*, 17 January 1985. Later work would cast doubt on these initial conclusions, and the state would distance itself from any implication that there was a link between contamination and cancer or birth defects in these communities, which activists in the Fairchild case attributed to industry pressure. M. Donald Whorton et al., "Problems Associated with Collecting Drinking Water Quality Data for Community Studies: A Case Example, Fresno County, California," *American Journal of Public Health* 78 (1988): 47–51; Margaret Wrensch et al., "Hydrogeologic Assessment of Exposure to Solvent-Contaminated Drinking Water: Pregnancy Outcomes in Relation to Exposure," *Archives of Environmental Health* 45 (1990): 210–16; David Naguib Pellow and Lisa Sun-Hee Park, *The Silicon Valley of Dreams: Environmental Injustice, Immigrant Workers, and the High-Tech Global Economy* (New York: New York University Press, 2002), 73–74.



38. Kern County Health Department, *Epidemiologic Study*.

39. *The Wrath of Grapes* (Keene, CA: United Farm Workers, 1986), videorecording; Michael W. Graf, "Regulating Pesticide Pollution in California under the 1986 Safe Drinking Water and Toxic Exposure Act (Proposition 65)," *Ecology Law Quarterly* 28 (September–October 2001): 663–753. Shortly afterward, Rosales and other families derided the UFW for what they saw as the union's political opportunism. Fred Setterberg and Lonny Shavelson, *Toxic Nation: The Fight to Save Our Communities from Chemical Contamination* (New York: John Wiley & Sons, 1993), 76; Ron Talbot, interview by author, 9 December 2003, Bakersfield, CA; Russell Clemings, "Cancer Probe Sought," *SB*, 6 September 1987.

40. Eliot Diringer, "State Hearing on Cancer 'Epidemic' in Central Valley," *SFC*, 17 October 1987 (Rosales quote); Setterberg and Shavelson, *Toxic Nation*, 206–11; Lloyd G. Carter, "Are Pesticides Killing the Children? Cancer Rate High in California Town," *Seattle Times*, 11 July 1988; Weisskopf, "Pesticides and Death"; Ron Harris, "Jackson to Put Campaign Focus on Cancer Cluster Town," *LAT*, 28 May 1988. Deukmejian would later veto a bill sponsored by Torres and Harvey that would have appropriated $330,000 for studies of McFarland (Memo from Clifford L. Allenby, Secretary of Health and Welfare, to David M. Caffrey, 13 January 1989, CDHS-McFarland files).

41. Weaver and Camposeco, "4th Valley Town" (Moses quote); Carter, "Are Farm Pesticides Killing the Children?" (Rosales quote); Ron Harris, "Jackson to Put Campaign focus on Cancer Cluster Town," *LAT*, 28 May 1988; Warren, "Mysterious Cancer Cluster." See also Scott, "Child Cancer Cluster Poses Puzzle."

42. Lionel Martinez, "Farm Laborers Struggle to Guard Against What's Causing Cancer," *BC*, 24 September 1988.

43. The political disenfranchisement of Latinos was a product of the fact that many were noncitizens and also a system of at-large elections that more easily allowed the white minority to maintain local political power. Krissman, "Cycles of Deepening Poverty," 183–96; Warren, "Mysterious Cancer Clusters." But as Michelle Murphy has pointed out, in the case of toxic exposures, not even whiteness is a guarantee of power ("Uncertain Exposures and the Privilege of Imperception: Activist Scientists and Race at the U.S. Environmental Protection Agency," *Osiris* 19 [2004]: 266–82).

44. One example is Paul Buxman, a farmer near Dinuba, who abandoned chemical pesticides after his son was diagnosed with leukemia. *In Our Children's Food* (Boston: WGBH, 1993), videorecording; Russell Clemings, "Couple Says It Paid High Price for Raising Alarm," *SB*, 15 February 1988; Julie Guthman, *Agrarian Dreams: The Paradox of Organic Farming in California* (Berkeley: University of California Press, 2004), 20.

45. On Deukmejian's overall disinterest, see Hal Rubin, "Strange Delays in the State's Cancer Probe," *SB*, 25 June 1989. On CDHS and CDFA, email from L. Goldman to R. Kreutzer et al. re: "Earlimart study/interest by CDFA, EPA," 15 September 1989; Memo to Lynn R. Goldman from Larry Nelson, Depart-

ment of Pesticide Regulation, Cal-EPA, re: "Comments on Phase III McFarland Report," 28 October 1991, CDHS-McFarland files.

46. Weaver and Camposeco, "4th Valley Town"; California Department of Health Services, "Epidemiologic Study of Adverse Health Effects in Children in McFarland, California—Draft Phase II Report" (Berkeley, 1988); Reynolds et al., "Four County Study of Childhood Cancer."

47. One of the clusters, Rosamond, lay outside of the valley proper; however, Rosamond was discovered to be the location of considerable toxic waste disposal. Setterberg and Shavelson, *Toxic Nation,* 215; Eliot Diringer, "5 Children of Farm Workers/New Cancer Cluster in Farm Town," *SFC,* 14 September 1989. The quote is from Daphne Washington, a KCDPH employee who had written a 1980 report on groundwater contamination in the county; it appears in Weiskopf, "Pesticides and Death."

48. Setterberg and Shavelson, *Toxic Nation,* 246–60 (description of meeting). Overall cancer rates among children in the southern San Joaquin Valley were not significantly different from rates in San Francisco and Los Angeles, and within the valley, those localities with the highest rates were the cities of Fresno and Bakersfield. However, cancer rates were slightly lower in rural areas that were not used for farming (Reynolds et al., "Four County Study" [quote on 696]). One of the lead epidemiologists on McFarland would later publish an article showing that, from a statistical standpoint, a certain number of "chance" cancer clusters were to be expected in a state the size of California. The implication was that McFarland was nothing more than a random aggregate of cases and that the cancers had no relationship to the local environment (Raymond Neutra, Shanna Swan, and Thomas Mack, "Clusters Galore: Insights about Environmental Clusters from Probability Theory," *Science of the Total Environment* 127 [1992]: 187–200).

49. Glen Martin, "Cluster: Random or Environmental?" *SFC,* 4 October 1998; Krissman, "California Agribusiness and Mexican Farmworkers," 212 n. 29. CDHS also continued to foster this discourse in subtle ways. Part of the response to the cluster had been the establishment of a child-health screening clinic, which community members had wanted as a means to have children screened for cancer and other chronic diseases. However, CDHS consistently emphasized in its newsletters that while no new cancers were detected through the screening program, "other problems" such as tooth decay, poor nutrition, and incomplete immunizations were prevalent. CDHS, "Update on Cancer among Children in McFarland," May 1996, KCDPH files.

50. Penny Newman, "Cancer Clusters among Children: The Implications of McFarland," *Journal of Pesticide Reform* 9 (Fall 1989): 10–13; Janny Scott, "Child Cancer Cluster Poses Puzzle," *NYT,* 21 September 1988; "Town's Cancer Deaths Prompt Call for Action," *SB,* 29 November 1987; "Kern Cancer Study Attacked," *SB,* 3 April 1987; Carter, "Are Farm Pesticides Killing the Children?"

51. Weaver and Camposeco, "4th Valley Town"; Warren, "Mysterious Cancer Cluster"; Mark Arax, "Cancer Mystery Still Plagues Farm Town," *LAT,* 14 August 1997; Setterberg and Shavelson, *Toxic Nation,* 258–60.

52. Lois Gibbs, "Social Policy and Social Movements," *Annals of the American Academy of Political and Social Science* 97 (November 2002): 98–109, 103.



On scientific and hermeneutic knowledge, see Bronislaw Szerszynski, Scott Lash, and Brian Wynne, "Introduction: Ecology, Realism and the Social Sciences," in *Risk, Environment and Modernity: Towards a New Ecology,* ed. Scott Lash, Bronislaw Szerszynski, and Brian Wynne (London: Sage, 1996), 1–26. On lay expertise and experience as an alternative form of knowledge, see Kroll-Smith and Floyd, *Bodies in Protest.* On the tension between experiential and abstract knowledge applied in a historical context, see Linda Nash, "The Changing Experience of Nature: Historical Encounters with a Northwest River," *Journal of American History* 86 (March 2000): 1600–29.

53. Working Group on Draft Report, McFarland Childhood Cancer Study, "Minutes," 16 March 1987, CDHS–McFarland files; "Petitions for Emergency Action in McFarland, California: Requests for Preliminary Assessment/Site Investigation, Hazard Ranking, and Emergency Removal and Abatement Actions," 1 March 1995, KCDPH files; Julie Durick, "Officials Search for Clues to McFarland Cancer Cases," *BC,* 28 June 1985. A 1989 study by CDHS revealed that people living or working near cotton fields had an increased incidence of respiratory problems. Tom Maurer, "Defoliation Stirs Up County Air," *BC,* 30 September 1993; Sally Connell, "Young Victims Recall Struggle with Cancers," *BC,* 24 September 1988 (Caudillo quote); Warren, "Mysterious Cancer Clusters" (bug quote); CDPH, *Community Studies on Pesticides,* 15 December 1969–1 November 1970, photocopy, 32 (comment about cancers).

54. Charles W. Schmidt, "Childhood Cancer: A Growing Problem," *Environmental Health Perspectives* 106 (January 1998): A18–A23; Michael Greenberg and Daniel Wartenberg, "Communicating to an Alarmed Community about Cancer Clusters: A Fifty State Survey," *Journal of Community Health* 16 (April 1991): 71–82 (1,500 requests).

55. Edelstein, *Contaminated Communities,* 161–92; Deborah Lupton, *Risk* (London: Routledge, 1999); James Flynn, Paul Slovic, and C. K. Mertz, "Gender, Race, and Perception of Environmental Health Risks," *Risk Analysis* 14 (December 1994): 1101–8.

56. Allan Mazur, *A Hazardous Inquiry: The Rashoman Effect at Love Canal* (Cambridge, MA: Harvard University Press, 1998); S. Schwartz, P. White, and R. Hughes, "Environmental Threats, Communities, and Hysteria," *Journal of Public Health Policy* 6 (March 1985): 58–77; Tim Aldrich and Thomas Sinks, "Things to Know and Do about Cancer Clusters," *Cancer Investigations* 20 (2002): 810–16; David Robinson, "Cancer Clusters: Findings vs. Feelings," *Medscape General Medicine* 4 (6 November 2002) [electronic resource].

57. Often the problem is blamed on the media, which experts argue exaggerate problems and misstate facts. However, studies of media representations of disease clusters have failed to find the kinds of bias that critics have assumed. My own extensive reading of the media in the McFarland case suggests that journalists typically presented the experts' position as authoritative while also reporting the frustrations of community members. For other analyses of the media in similar situations, see Michael Greenberg and Daniel Wartenberg, "Newspaper Coverage of Cancer Clusters," *Health Education Quarterly* 18 (Fall 1991): 363–74; Mazur, *Hazardous Inquiry;* Dorothy Nelkin, *Selling Science: How the Press Covers Science and Technology,* rev. ed. (New York: W. H. Freeman, 1995).

58. I am oversimplifying here to some extent. In fact, epidemiology recognizes the problem of "interaction" among risk factors. Yet interaction is typically subordinated to independent disease-exposure relationships. Hence the overwhelming emphasis on controlling confounding "bias" through study design and appropriate statistical analysis. K. J. Rothman, "Causes," *American Journal of Epidemiology* 104 (1976): 587–92. Moreover, the more recent emphasis on "meta-analysis" (the combination of results from a series of studies conducted among different groups) implicitly assumes that there is an underlying universal exposure-disease relationship that is not context dependent. On all of this, see Wing, "Limits of Epidemiology"; Naomar Almeida-Filho, "The Epistemological Crisis of Contemporary Epidemiology: Paradigms in Perspective," *Sante Culture Health* 8 (1991): 145–66.

59. On individualism in epidemiology, Sylvia Noble Tesh, *Hidden Arguments: Political Ideology and Disease Prevention Policy* (New Brunswick, NJ: Rutgers University Press, 1988); Robert A. Aronowitz, *Making Sense of Illness: Science, Society, and Disease* (New York: Cambridge University Press, 1998); Wing, "Limits of Epidemiology."

60. CDHS, *Toxicological Aspects of DBCP;* R. Cooper and R. David, "The Biological Concept of Race and Its Application to Public Health and Epidemiology," *Journal of Health Politics, Policy, and Law* 11 (1986): 97–116.

61. Bullard, *Dumping in Dixie;* Edelstein, *Contaminated Communities,* 233–41; U.S. Government Accounting Office, *Siting of Hazardous Waste Landfills and Their Correlation with Racial and Economic Status of Surrounding Communities* (Washington, DC, 1983), www.gao.gov; Moses et al., "Environmental Equity and Pesticide Exposure." Also, a study published in 2001 found that Hispanic farmworkers had higher rates of several cancers than other Hispanics in California. Though the authors did not suggest any explanations, this study provided evidence for those who link pesticide exposure to cancer in the valley. Paul K. Mills and Sandy Kwong, "Cancer Incidence in the United Farmworkers of America (UFW), 1987–1997," *American Journal of Industrial Medicine* 40 (2001): 596–603; Kim Baca, "Hispanic Farmworkers in California Suffer High Cancer Rates," *Houston Chronicle,* 18 March 2002.

62. Quoted in Setterberg and Shavelson, *Toxic Nation,* 71, 136.

63. Testimony of Dr. Leon Hebertson in California Senate, *Childhood Cancer Incidences,* 26–27; "Duke: The Terminator," *California Journal* 19 (February 1988): 85–88; "Dr. Ken Kizer: The State's High-Profile Health Chief," *California Journal* 18 (June 1987): 291–93; Stephen Green, "Glitches, Gremlins and Soap: Staggering Along the Road to Toxic Waste Reform in California," *California Journal* 16 (September 1985): 344–48.

64. Raymond Richard Neutra, "Counterpoint from a Cluster Buster," *Journal of Epidemiology* 132 (July 1990): 1–8; Rothman, "Sobering Start." The most celebrated study was that done of the Woburn leukemia cluster by researchers at the Harvard School of Public Health. The initial study showed a positive correlation between groundwater contamination and cancer incidence; however, later investigators identified several problems with the study and challenged its conclusions. See Steven Lagakos, Barbara J. Wessen, and Marvin Zelen, "An Analysis of Contaminated Well Water and Health Effects in Woburn, Massachusetts," *Journal of the American Statistical Association* 81 (1986): 583–96. Brown and Mikkelson discuss critiques of that investigation (*No Safe Place,* 24–27).



65. J. P. Vandenbroucke, "Is 'the Causes of Cancer' a Miasma Theory for the End of the Twentieth Century?" *International Journal of Epidemiology* 17 (1988): 708–9; Alvan R. Feinstein, "Scientific Standards in Epidemiologic Studies of the Menace of Everyday Life," *Science* 242 (2 December 1988): 1257–63; Mark Parascandola, "Epidemiology: Second-Rate Science?" *Public Health Reports* 113 (July–August 1998): 312–20. In particular, the tobacco industry had long focused on discrediting epidemiologic methods (David Egilman, Joyce Kim, and Molly Biklen, "Proving Causation: The Use and Abuse of Medical and Scientific Evidence Inside the Courtroom—An Epidemiologist's Critique of the Judicial Interpretation of the Daubert Ruling," *Food and Drug Law Journal* 223 [2003]: 223–50, via LexisNexis).

66. Richard Jackson, "Chemicals and Chromosomes, Children and Cancer, Clusters and Cohorts in a New Century," in *Cancer and the Environment: Gene-Environment Interaction,* ed. Samuel Wilson, Lovell Jones, Christine Coussens, and Kathi Hanna (Washington, DC: National Academy Press, 2002), 92–93; Rothman, "Sobering Start," 6; P. A. Schulte, R. L. Ehrenberg, and M. Singal, "Investigation of Occupational Cancer Clusters: Theory and Practice," *American Journal of Public Health* 77 (1987): 52–56; "Why Community Cancer Clusters are often Ignored," *Scientific American* 275 (September 1996): 85. One result is that the field in recent years has emphasized controlled clinical studies (Almeida-Filho, "Epistemological Crisis").

67. Martin, "Cluster: Random or Environmental?", Aronowitz, *Making Sense of Illness,* 166; Dana Loomis and Steve Wing, "Is Molecular Epidemiology a Germ Theory for the End of the Twentieth Century?" *International Journal of Epidemiology* 19 (1990): 1–3. In epidemiology the influence of the laboratory paradigm is partly evidenced by the turn toward sophisticated mathematics (Susser, "Epidemiology after World War II").

68. Charles W. Schmidt, "Toxicogenomics: An Emerging Discipline," *Environmental Health Perspectives* 110 (December 2002): A750–55; Kenneth Olden, Janet Guthrie, and Sheila Newton, "A Bold New Direction for Environmental Health Research," *American Journal of Public Health* 91 (December 2001): 1964.

69. Proctor, *Cancer Wars,* 171–72; Maren Klawiter, "Chemicals, Cancer, and Prevention: The Synergy of Synthetic Social Movements," in *Synthetic Planet: Chemical Politics and the Hazards of Modern Life,* ed. Monica J. Casper (New York: Routledge, 2003), 155–76; Eileen M. McGurty, "From NIMBY to Civil Rights: The Origins of the Environmental Justice Movement," *Environmental History* 2 (1997): 301–23; Robert Gottlieb, *Forcing the Spring: The Transformation of the American Environmental Movement* (Washington, DC: Island Press, 1993); Philip Shabecoff, *A Fierce Green Fire: The American Environmental Movement,* rev. ed. (Washington, DC: Island Press, 2003), 243–64; Bullard, *Confronting Environmental Racism;* Andrew Szasz, *EcoPopulism: Toxic Waste and the Movement for Environmental Justice* (Minneapolis: University of Minnesota Press, 1994).

70. See, e.g., Penn Loh and Jodi Sugarman-Brozan, "Environmental Justice Organizing for Environmental Health: Case Study on Asthma and Diesel Exhaust in Roxbury, Massachusetts," *Annals of the American Academy of Political and Social Science* 584 (2002): 110–24.

71. On the reappropriation of both the body and differentiated space as a political strategy, see Lefebvre, *Production of Space*, 194–205. Also Neil Smith, "Antimonies of Space and Nature in Henri Lefebvre's *The Production of Space*," in *Philosophy and Geography II: The Production of Public Space*, ed. Andrew Light and Jonathan M. Smith (Lanham, MD: Rowman & Littlefield, 1998), 49–69.

72. The sociologist Phil Brown has labeled these tactics "popular epidemiology" (Brown and Mikkelson, *No Safe Place*).

73. "You're always walking on eggshells. Anything happens to your child and you run to the doctor because you want to make sure it's just the flu, it's just tonsillitis and not something else." Quote of Irma Alcala in Greg Campbell, "Under the Microscope in McFarland, Again," *BC*, 16 June 1996.

74. "Petitioned Public Health Assessment: McFarland Study Area, McFarland, Kern County, California," at www.atsdr.cdc.gov/HAC/PHA/mcfarland/msa_pl.html (accessed 2 October 2003). In addition, community members specifically requested that the Kern County Health Department and the California Department of Health Services not be involved in the new studies. This and opposition of "Anglo elite" from "Memo from DEODC [Division of Environmental and Occupational Disease Control, CDHS] to Kim Belshe via Genest Munso re: McFarland," 12 April 1996, CDHS-McFarland files; "Notes from Meeting with EPA 8/27/915?]," KCDPH files (opposition of KCDPH); CDHS, Environmental Health Investigations Branch, "Update on Cancer Among Children in McFarland," May 1996, KCDPH files.

75. In 1986, a U.S. EPA study on chemicals in human tissue found measurable levels of styrene and ethyl phenol in nearly all adults tested in the United States. Ninety-six percent had clinical levels of chlorobenzene, benzene, and ethyl benzene, 91 percent showed toluene, and 83 percent had detectable levels of polychlorinated biphenols. Jon S. Stanley, *Broad Scan Analysis of Human Adipose Tissue — Executive Summary*, EPA Contract B560/5–86/035 (Springfield, VA: National Technical Information Service, 1986). On the self-refuting nature of modern institutions such as public health, see Beck, *Risk Society*.

76. Dr. Robert Haile of UCLA cited in Setterberg and Shavelson, *Toxic Nation*, 252.

77. Murphy, "The 'Elsewhere within Here'and Environmental Illness." For a similar finding in a somewhat different context, see Martha Balshem, *Cancer in the Community: Class and Medical Authority* (Washington, DC. Smithsonian Institution Press, 1993). For the variety of ways in which bodies are understood even within western biomedicine, see Mol, *Body Multiple*.

78. Raymond Richard Neutra, "Should One Start or Continue a Line of Research? Stakeholders' Interests and Ethical Frameworks Give Different Answers," *Annals of the American Academy of Political and Social Science* 584 (November 2002): 125–34.

79. On persistence of concerns, Martin, "Cluster: Random or Environmental?"



## CONCLUSION

1. Stanley, *Broad Scan Analysis of Human Adipose Tissue — Executive Summary*.

2. For more on this point, see Mitman, "In Search of Health."

3. Some scholars have emphasized the role of the state over that of the market in this regard, particularly with respect to the abstraction and modernization of the landscape. However, in the Central Valley, the state has more often worked in tandem with the market; moreover, both interpretations rely on the assumption of a human/nature dichotomy. For state-centered interpretations, see James C. Scott, *Seeing Like a State: Why Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press, 1999); Worster, *Rivers of Empire*. For a critique of Scott, see Fernando Coronil, "Smelling Like a Market," *American Historical Review* 106 (February 2001): 119–29. For the human/nature dichotomy in state-sponsored science and its limitations, see Nash, "Changing Experience of Nature."

4. In contrast, the sociologist Ulrich Beck and others have argued that contemporary political conflicts over environmental health are principally arguments about the *institutions* of modernity in industrialized society. What these institutional accounts neglect is the fact that these conflicts are also about particular environments and places. Beck, *Risk Society;* Ulrich Beck, *Ecological Politics in an Age of Risk*, trans. Amos Weisz (Cambridge: Polity Press, 1995); Scott Lash, Bronislaw Szerszynski, and Brian Wynne, eds., *Risk, Environment & Modernity: Towards a New Ecology* (London: Sage, 1996).

5. Lefebvre, *Production of Space*, 200–202.

6. My approach to questions of medicine and disease here is influenced by Mol, *Body Multiple*.