

Introduction

SIERRAN SHADOWS

HARDLY AN AMERICAN SOUL has been untouched by the Sierra Nevada. You need only to have consumed a fruit cup or a handful of almonds, to count among your ancestors a former slave, or to benefit from living in the world's number-one economy to cite an example of how a mountain range you may never have seen has altered your life. Even more directly, sitting in a cool movie theater on a hot summer day, visiting a national park, gambling in Las Vegas, or skiing down a mountain in the West, you owe your experience in no small part to the Sierra Nevada and the way it has shaped our nation's historical development.

Certainly the Sierra Nevada is not alone among geographic features in influencing the course of American history. The same could be said for the Appalachian Mountains, the Mississippi River, the Great Plains, the Rocky Mountains, or any number of other landscape icons. What's special about the Sierra? For one thing, the Sierra's existence and characteristics have impacted our lives and our history in ways that are startlingly diverse, manifestly consequential, and often unexpected. Further, while other mountains and some large rivers arguably helped define America—the British prohibition on moving past the Appalachians, for example, energized colonial revolutionaries—the Sierra emerged on the national stage quite unexpectedly and in the process *redefined* the country. Of particular interest from my standpoint as a geologist, the enormous impact of the Sierra was far more tied to the peculiarities of the geologic history of the range than was the case with the Appalachians. Change any of a number of aspects of the deep-time history of the Sierra—move erosion back a few million years, shift a major fault a few miles east or west—and American history would have followed a dramatically different path.

For evidence of the Sierra Nevada's imprint on our lives, consider the theatergoers I mentioned above. Aside from making appearances in movies—the Sierra has stood in for the Yukon's Chilgoat Pass in Chaplin's *The Gold Rush* and for Afghanistan in *Iron Man*, to name just two of several hundred guest shots—the Sierra has played a significant role in the development of Hollywood. The capital of the film industry has been in the greater Los Angeles area for about a century. While the locale's appeal was mainly climatic, for the industry to grow there needed to be a vibrant city. By the beginning of the twentieth century, this was far from guaranteed. Los Angeles had pretty nearly exhausted its local water resources. City officials and leading businessmen in the region arranged for water to be brought from the Sierra, a process later memorialized (or vilified) in the movie *Chinatown*. This water would fuel the growth of the region and with it the film industry through a good part of the twentieth century. Not only was the water Sierran, but the development of the laws, culture, and infrastructure allowing the water to move over such distances owed a great deal to events in the range.

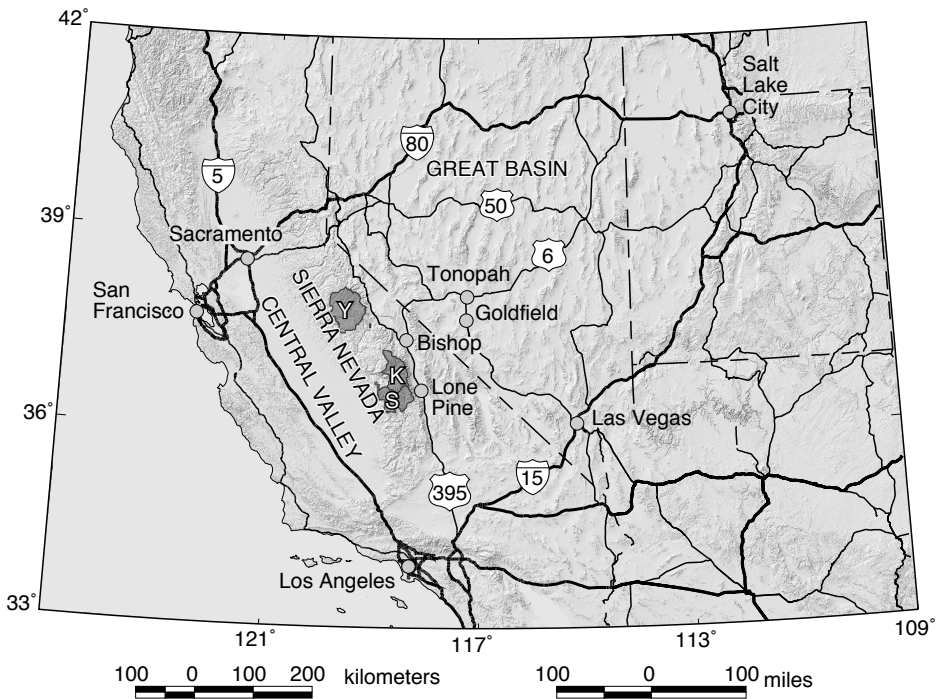
The film industry and the water that made Hollywood possible come together in and around Lone Pine, a modest town of fewer than three thousand people at the base of the Sierra Nevada's steep eastern escarpment, near the bottom of a valley deeper than the Grand Canyon. To the west, Sierran peaks tower 10,000 feet over the valley floor, and to the east those of the Inyo Mountains rise more than 6,000 feet above town.

To advance from Lone Pine toward the granite wall of the Sierra to the west, you first have to traverse what almost appears to be a giant's rubble pile. These picturesque rocks comprise the Alabama Hills and are the same granites as in the Sierran wall to the west; their curious erosion into lumpy boulders is a reflection of the different climate far below those peaks. By 1920 the area had been frequented by at least one of Hollywood's earliest movers and shakers, leading several production companies to drive the few hours from Hollywood to use the combination of the rugged peaks and peek-a-boo views through and around the piles of boulders as backdrops for their growing catalog of movies. Although the Alabama Hills would over the years stand in for many Old World localities in movies like *Gunga Din* and *Charge of the Light Brigade* and out-of-this-world locations in two *Star Trek* movies, the bread-and-butter of the local film economy was the Western, starting with the very first film made here, *The Roundup*, starring Fatty Arbuckle. For the next forty years the hills echoed with stage directions as the Lone Ranger and Hopalong Cassidy and others created the mythic West for America and the world.¹

All this activity was enabled by a very different invasion from the south some years earlier. Drought just after the turn of the twentieth century had made it clear that Los Angeles could grow only with more water. The superintendent of the Los Angeles Department of Water and Power had decided in 1904 that the Owens River, then watering some 40,000 acres of crops north from Lone Pine, would satisfy the emerging metropolis. By hijacking the nascent Bureau of Reclamation's plans to irrigate even more of the valley, Los Angeles acquired rights to most of the Owens River's water (and most of the valley). Less than a decade later, Owens River water poured down into the San Fernando Valley through the L.A. Aqueduct, ending plans for growth in Owens Valley as it made land speculators in Los Angeles wealthy.² Even as moviemakers came to Lone Pine, an end to a string of wet years led to physical conflicts as the remaining irrigation districts fought Water and Power for control of Owens River water. This reached an improbable turn in November 1924, when residents seized an aqueduct gatehouse outside of Lone Pine and turned the L.A. Aqueduct's water back into Owens Lake. This act of sabotage was followed not by gunfire but by a picnic, enlivened by the orchestra of Tom Mix, who sent the musicians over when he learned of the event from his nearby movie set. Subsequent confrontations were more cinematic, as the aqueduct was dynamited repeatedly in 1927 and shoot-to-kill orders emanated from Water and Power's headquarters. The collapse of the main banking establishments in Owens Valley only a few months later ended resistance to Los Angeles, and over the following twenty to thirty years, agriculture in the valley faded away, replaced entirely by the tourist and movie-making service industry.³

Among the attractions of the modern tourist industry are the views the moviemakers had coveted. Loiter outdoors in Lone Pine awhile, and you will almost certainly see arms pointing westward or overhear someone asking, "Which one is Whitney?" The highest peak of the Sierra Nevada—of California, of the contiguous United States—is in plain view, but nearly every first-time visitor will pick bulky Lone Pine Peak as the highest. The mistake is understandable; Lone Pine Peak rises farther above the horizon when viewed from Lone Pine than does Whitney. The reason is simple perspective: at the foot of the Sierra, you are too close for an undistorted vista.

For a better introductory view of the Sierra, you might head north out of Lone Pine, drive a few miles to Independence, and turn east on a dusty road that crosses the fault scarp of what was probably the strongest earthquake in California history before it winds up into the Inyo Mountains toward Mazourka Peak. From a vantage point up in the Inyo Mountains, you now can



MAP 3. Locations of the southwestern United States, with federal highways. Sierran national parks indicated by shading: Yosemite (Y), Kings Canyon (K), and Sequoia (S).

really grasp, across the Owens Valley, the extent of the wall of rock that is the Sierra. The lowest point on the crest in view is Sawmill Pass, over 11,000 feet above sea level and more than 6,000 feet higher than the valley below you. The wall of rock that you can see extends from well south of Lone Pine to near Bishop, a distance of about 100 miles. But this is only the range's southern portion. The Sierra crest continues, unbreached by a river, until some 400 miles farther north, well north of Lake Tahoe. To cross the range by car in the winter, the traveler would need to drive some 95 miles south of Independence to Walker Pass or more than 220 miles north to Carson Pass. It is hardly less daunting in the summer: once the snow melts, you can turn west 70 miles south of Independence to cross on the little-used Sherman Pass road or go 105 miles north to head west over Tioga Pass. Between these two roads there is no automobile crossing of the range—you can drive 175 miles along US Highway 395 knowing that any road heading toward the range is a dead end (Map 3).

Looking at the Sierra from your perch in the Inyo Mountains, you are peering at the edge of two great national parks: Sequoia and Kings Canyon. Below that skyline ridge, the John Muir Wilderness within Inyo National Forest encompasses the slopes that buffer the parks from the desert below. Yosemite's famous cliffs and waterfalls are somewhere well behind the crest of the massive wall of rock you are looking at. Although the eastern side of the Sierra is lightly clothed in a pine forest, the western slope is generously draped in one of the better coniferous forests in the world, one endowed with the largest of trees by volume, the giant sequoia. Your view from the east easily captures views of the divide between waters heading to the Pacific and those doomed to evaporate in the Great Basin (or flow through canals and tunnels to water the greater Los Angeles area). Those examining the range from a typical vantage point on its west slope—gaping at views from Moro Rock in Sequoia, for example, or from Glacier Point in Yosemite—are unable to see this divide because they are so far from the crest.

Your edge of the Sierra is brutally ragged and easily drawn; the western edge, a sinuous and ill-defined boundary. This eastern edge is raw from recent geological insult, whether it be from the glaciers that sharpened the peaks, the earthquakes that dropped the valley, or the volcanoes that simply obliterated the old edge of the range. That western edge, in contrast, is probably the most stable part of California, its only real geologic violence the occasional wash of rivers flooding over lands near their usual banks. Those used to viewing the range from the west—seeing from most vantage points low hills gradually emerging from under the rich loam of the Central Valley and higher hills some distance away—would find the abrupt appearance of the mountains above Lone Pine and Independence utterly unfamiliar.

Just as the range is clearly a huge barrier to travel, it is also a barrier to moisture, and in this aspect we encounter another important way—both literal and figurative—in which the Sierra casts its shadow. The Sierra Nevada's rain shadow effect is certainly evident from the skimpy vegetation around your viewpoint, but it is more thoroughly demonstrated by the landscape around the town of Tonopah, just over 100 air miles to the northeast in the state of Nevada. To get to Tonopah, you drive north out of Independence and join US 6 in Bishop. The drive has long straight stretches of road unimpeded by forest or town or river; only the need to climb over the hills at the north edge of the White Mountains causes the road to curve. Dropping down to the east, you see such shrubs as make their home here crouch close to the ground, ready to nip your ankles should you venture too

close, but otherwise cowering beneath a dome of dry air attempting to suck the plants dry. Gentle slopes seemingly bleached of color rise to rocks dyed from a strange palette of reds, blacks, and light tans. As these rocky summits recede into the distance, tints from the sky seep down to soften the land and shade it toward grays, blues, and purples. Into this landscape you venture to find Tonopah, huddled between some pointed hills atop a narrow mountain range, the most bustling community for hundreds of miles—which, in rural Nevada, isn't saying much.

Here you stand 5,394 feet above sea level—as high as some of the highest peaks in the Appalachians—and so you might expect Tonopah to be clothed in a cool forest. Instead the landscape is parched. A few junipers huddle in the more sheltered sides of some of the peaks but for the most part there are just scattered hardy shrubs in the few places where miners didn't burrow into the ground or deposit their tailings. Although the Sierra is a distant smudge on the horizon only seen from certain favored spots, its shadow over the physical and historical reality of Tonopah is unmistakable. It has exacted a toll on the storms that pass from west to east at this latitude, and in demanding the moisture from these storms, it has left Tonopah a high desert.

A comparison of statistics underscores the severity of the climatic effect. Grant Grove on the west side of the Sierra gets an average of about 42 inches of precipitation (mostly as over 190 inches of snow) each year. In January the average low is 25°F; in July the average high is 75°F.⁴ Tonopah, a bit lower but not so much that it should make much of a difference, gets only 5 inches of precipitation a year, mostly in the form of rain. Even without the snow, Tonopah in winter is colder than Grant Grove, and in summer sees high temperatures hotter by 13°F. Thus Grant Grove hosts a thick forest of pines, firs, and sequoias—not to mention lots of park visitors—while Tonopah struggles to prevent buildings from collapsing into the street. Push the Sierra out of the way and Tonopah becomes a garden spot.

The climatic effects observed in Tonopah are widespread. In California, the west slope of the Sierra Nevada drains into the Sacramento and San Joaquin Rivers. Although the flows of these streams have been altered by engineering longer than their flows have been directly measured, geologic evidence suggests that something like 1,100 cubic meters of water (more than 290,000 gallons) have entered San Francisco Bay each second of the past many thousands of years. This is water collected from about 43,200 square miles of California and is equal to the wonky waterworks measure of 28 million acre-feet of water per year (an acre-foot is the amount of water needed to drown an acre under a foot of water).

The 172,000 square miles of land just east of the Sierra, the Great Basin—four times the area draining to the Pacific on the west—gets so little water and has so much evaporate that no river reaches an ocean. Even the Colorado drainage farther east is starved for moisture: despite draining an area more than twice as large as that draining into San Francisco Bay, the Upper Colorado only has about half of the flow of the Sacramento and San Joaquin Rivers.⁵

Even the name of Tonopah's state is in the shadow of the Sierra Nevada, for when the territory was first blocked out, the original name was to be Sierra Nevada Territory. Congress, ignorant of either Spanish or the territorial geography, or simply in a jovial mood, dropped the *Sierra* and left the *Nevada*, which in Spanish means "snowy."⁶ Although snow is not a particularly defining characteristic of the region, a one-word name was simpler and *Nevada*, perhaps, a less generic name than *Sierra*. Only a few short years later, driven by the need for a few more electoral votes to assist Abraham Lincoln in his 1864 reelection bid, the state convention in Carson City sent the longest telegram in history to Washington D.C. on the 31st of October 1864: a message containing the constitution for the new state to be made from Nevada Territory.⁷ Despite misgivings in the convention on the naming of the state, the constitution was for a new state of Nevada.⁸ And so we find one unusual outcome of the Sierra Nevada's presence just in the name of the state that includes no more than a narrow sliver of the range.

As America approached the beginning of the twentieth century, desiccated Nevada seemed destined to revert to the fate early emigrants imagined for it: a desolate land with few people and no reason for others to stop. The massive Comstock Lode justifying the Silver State's nickname was more than twenty years past its richest days. Unlike California, where agriculture overtook mining while mining was still strong, Nevada's climate, victim of its namesake range, precluded riches from farming. Newer mining booms across the state seemed to be smaller and smaller as, it seemed, the riches in the rocks were nearing exhaustion. The state, brought into the Union on the back of its mineral wealth, was now the target of suggestions that it join its numerous ghost towns and be demoted from statehood.⁹

A new silver strike near Tonopah in 1900, and then a gold find a bit farther south in Goldfield, retired talk of demoting the state. The finds were the stuff of legend: miners from around the state descended on Tonopah, and Goldfield grew so fast that it captured the title of Nevada's largest city in 1906. But although this mining activity produced some great bonanzas, it proved to be short-lived and the last of the old-time mineral rushes.¹⁰ As these

finds faded away, Nevada leaders recognized that they needed to supplement mining to ensure the viability of the state.

Nevada politicians became inventive. As there wasn't the water or the climate for intense and successful agriculture, the state sought to attract visitors. The first great enticement was a very liberal divorce law. Unlike the rest of the country, Nevada would grant a divorce to those who resided in the state for a short time without any need for proof of irreconcilable differences or extensive litigation. State legislators even reduced the minimum length of residence from six months to three months in 1927 and then to six weeks in 1931 to increase visitation and stave off competition from other states. A booming business developed in divorce ranches, places for soon-to-be divorcees to enjoy themselves while waiting out the last days of their marriages.¹¹

That same desire to entice visitors and new residents led Nevada in 1931 to remove restrictions on gambling previously put in place in 1910.¹² One notable beneficiary was a small town in southern Nevada on the railroad line from Los Angeles to Salt Lake City.¹³ It originally handled shipments of ore from mines near Goldfield, but its position on a main route out from Los Angeles enabled Las Vegas to become the primary gambling destination for the population of Southern California. The relaxation on "gaming," as Nevadans put it, in 1931 couldn't have been better timed to take advantage of the influx of workers building Hoover Dam nearby. And so the harsh Nevada climate, imposed by the range of granite to the west, produced modern Las Vegas—"Everyman's cut-rate Babylon," in the words of Alistair Cooke.¹⁴

In focusing on the Sierra's impact on the physical geography of the West, I have made no mention of its better-known historical impact: gold. Although the discovery of Sierran gold in 1848, the subsequent rush, and the pulse of its economic stimulus are common knowledge, the many ways that the effects of the Gold Rush reverberated through society are less well known. One interesting thread of causality passes, coincidentally enough, through Las Vegas.

The original settlers of Las Vegas were members of the Church of Jesus Christ of Latter-Day Saints (LDS), commonly known as the Mormon Church. When they built a small adobe fort in what is now Las Vegas in 1855, the Mormon missionaries intended their settlement to be a way station along a year-round route that foreign converts could use to reach the church's homeland in the Salt Lake Valley.¹⁵ Although the settlers were recalled by the church in 1857 in response to a threat on Salt Lake City from federal troops, these missionaries might never have arrived in southern Nevada to establish a settlement had the LDS church not survived an earlier crisis.

Brigham Young had chosen Salt Lake Valley as the church's home in 1847 largely because of its isolation from the rest of American society. After forcible evictions in Missouri and Illinois, Young and the Mormon brethren wanted above all else to be left in peace. Occupying one of the few watered niches in the deserts of the West ensured an absence of American company, and so Young had resisted the pleas of another church elder, Samuel Brannan, who had brought part of the church to San Francisco Bay, for the church to continue its westward travels to California.¹⁶

Although Young had found his church a refuge, he had also placed it in rather grave poverty. Lacking even a real wagon road to the industrial world, church members needed basic products like stoves, plows, fabric, and clothing and were running perilously low on food. Even were such items available, the brethren had little hard cash with which to buy them, as their efforts were focused on making their community self-sufficient, not growing cash crops suitable for trade. In the grip of despair in the winter of 1849, Young's right-hand man, Heber C. Kimball, made one of the more famous prophecies in the Mormon Church's history: "In less than one year there will be plenty of clothes and everything that we shall want sold at less than St. Louis prices."¹⁷ Sierran gold—discovered the previous year—made Kimball's prophecy stand, as a few months later, gold seekers flooded through Salt Lake City, willing to sell at low, low prices their excess material goods and to trade their exhausted stock for horses or oxen that could survive the brutal trek across the deserts to the west. Perhaps the LDS church would have survived without that boon of merchandise brought to its doorstep, but the Mormon faithful would have faced more hard years and could have easily suffered the fate of other idealistic colonies of midnineteenth century America and faded from view.

Others even more persecuted than the Mormons would benefit from that gold find, too, though not in nearly as obvious and direct a manner, for the gold would trigger a number of events that climaxed in the Civil War and the associated abolition of chattel slavery.¹⁸ Although one main line of consequences was political—the request of California to be admitted as a free state triggered political chaos—arguably the more forceful effect was economic. Prior to 1849, the national economy rested on agriculture: it represented 70 percent of national production in 1839; manufacturing, only 17 percent. The 1840s had seen only about a 4 percent yearly increase in national product in constant dollars. The infusion of capital represented by Sierran gold spurred the process of industrialization, expanding annual growth to more than 5 percent and nearly doubling the share of income from manufacturing by

1860.¹⁹ With the bulk of that industrialization focused in northern states, California gold helped tilt the balance of resources northward, making defeat of the Confederacy—and the abolition of slavery—that much more likely.

Even as Sierran gold flowed into the banks and businesses of the eastern part of the United States, Sierran gold miners flooded much of the western part. Lured by the never-dying hope of finding a big strike, miners redefined the way America settled the West. Previously, Native Americans could have anticipated the steady march of the frontier's edge as new farms were plowed west of older farms. With the advent of the Gold Rush, suddenly and with no real warning a small party of whites that might have seemed to drop out of the sky might lay claim to a patch of colored rock and invite in a flood of others to form a mining camp, bristling with firearms and righteousness. The continuous frontier boundary between Euro-American settlement and "wilderness" often celebrated in history classes was demolished; a steady erosion of Indian lands at the edges of white settlement was augmented by an unpredictable pox of urban camps appearing throughout the region.²⁰

In making their camps in previously unorganized (from a U.S. perspective) territory, miners brought their biases in how laws should work. Resource law would bend toward mining, gifting it with timber and water and land. The Sierran model for development would form the basis for life in most of the western states. Although the cowboy has taken the popular high ground in the history of the West, the miner was the more effective colonizer.

As mining expanded elsewhere, other trends would emerge in the Sierra. The sheer voracity of mining and associated development made the preservation of anything not to be so abused a pressing concern. Californians requested the withdrawal of public lands from private entry to preserve the natural beauty of Yosemite Valley as a park. This established the basis for the national parks as we know them today. Continued and vibrant threats to the natural landscapes of the Sierra would eventually promote a kind of outdoors-oriented organization not previously seen in America, one dedicated from the start to advocating for governmental action to preserve nature from the industrial activities that had brought most Americans to the region. In this way the modern environmental movement began on the granite back of the Sierra Nevada.

The Sierra Nevada has shaped who and what we are as a nation in a multitude of ways far from exhausted by the foregoing sketches. Its effects in the areas of culture, economics, social organization, land use, and resource law have rippled throughout the United States and outward across borders and

oceans. Had the Sierra been no more than a set of western hills, the world today would be very different.

A typically brief description of the geology of the range sheds little light on how the Sierra Nevada came to be much more than a row of inconsequential hills. Such a description might go like this: The high eastern part of the range is nearly entirely made of granitic rocks of slightly different composition. In the northern Sierra, the western part of the range comprises older sedimentary and volcanic rocks cooked and squashed into near-vertical alignment. Atop these different flavors of bedrock are veneers of glacial debris in the very high parts of the range and a flood of volcanic rocks in the whole of the northern part of the range. Hidden within this portrait is the reason for the potency of the 1848–49 Gold Rush, the peculiar allure of Yosemite Valley, the presence of seemingly wild lands despite human utilization since the last Ice Age. Hidden too is an element of the geologic history that underlies nearly everything to which we can attach human significance: erosion. Although much of the history of the area depends on the geology that produced the variations in granite, slate, moraine, and volcanic rock, erosion was the ultimate key exposing these variations to human contact. And as erosion requires there to be an elevated area to be eroded, learning how the mountains came to be mountains is important when recognizing the factors dictating the human history here. As earth scientists have wrestled with these issues, the Sierra has turned out to be unexpectedly complex; not only has the range greatly changed American history, but it is also changing our views on the very fundamentals of how mountains are formed. And so the time is ripe to visit the web that connects geology and history.