

The *Natural* Setting



California, an “Island” World

At first, Europeans conceived of California as an island. Even before the Spaniards encountered the region, the name appeared in an early sixteenth-century novel, Garcé Ordoñez de Montalvo’s *Las Sergas de Esplandián*. “Know ye,” wrote Montalvo, “that at the right hand of the Indies there is an island named California, very close to that part of the Terrestrial Paradise. . . . The island itself is one of the wildest in the world on account of the bold and craggy rocks. . . . The island everywhere abounds with gold and precious stones, and upon it no other metal was found.” A few decades later, perhaps in jest, early Spanish mariners gave the name “California” to the first land they sailed to north and west of Mexico, which they scorned as a bleak island. Later explorers eventually discovered that California was actually part of the North American mainland. Ironically, naive original impressions, though geographically false, turned out to be ecologically true.

Although physically attached to North America, California can still accurately be described as an ecological island, its natural history distinct from that of the rest of the continent. Winds, currents, mountains, and deserts isolate the region biologically, almost as effectively as if it were girthed by an ocean moat, and its unique climates and landscapes create a potential for diverse and distinctive life forms unmatched elsewhere on the continent. As many have observed, California is home to the extreme, the unusual, and the spectacular, a veritable “island upon the land.” Throughout its human occupation, California’s exceptional landscapes, climates, and life forms have nurtured distinctive economies and cultures. Only against such a powerful and dynamic natural setting can we understand the drama of the region’s human history.

The Dynamic Landscape

Nature is often popularly assumed to be static and eternal, a stable benchmark against which to measure the ups and downs of human affairs. Actually, nature is dynamic. Oceans rise and fall. Whole continents meander around the globe. Mountain chains burst from the earth's surface, then sink below it again. Plants and animals evolve, some becoming new species, others dying out altogether. Climates change from frigid to torrid, humid to arid, and back again. Radically different ecological communities follow one another on the same landscape. Thus has it been for billions of years. Although they usually developed slower than a creeping glacier, these changes have been no less revolutionary.

No locale better illustrates nature's dynamism than California. For hundreds of millions of years, the region's landscape has been evolving. The present coast generally coincides with the borders between the North American and Pacific plates in the earth's crust. These plates continually interact, grinding together, pushing apart, and slipping sideways against each other. This gnashing of plates has made the Pacific Coast a particularly active geological region, with dramatic earthquakes, volcanic eruptions, and frequent shifts in elevation. Over the last hundred million years, mountains have been pushed upward by subterranean pressure or by lava from volcanic eruptions, only to be whittled back down by water and wind erosion, and then their rock and soil to be reformed into other landscapes elsewhere. As the earth heaved and sank, seas roamed back and forth across the landscape. At times, nearly all of California was under water; at others, the coastline was many miles west of its present location. Marshes and forests flourished in turn, and then were buried under hundreds of feet of sediment.

The present landscape began to emerge about thirty million years ago. The Pacific Plate began to drift northward along the San Andreas Fault, where it borders the North American Plate. Over millions of years, it carried part of the Baja California peninsula north, forming the present coastline from San Francisco Bay south to the Imperial Valley. Between ten and 20 million years ago, the Sierra Nevada mountain range loomed up and tilted west (it is still rising). As the younger Coast Range took shape, the great Central Valley—then a vast inland arm of the sea—gradually filled with sediment eroding from surrounding mountains. About two million years ago, the world's climate turned cold, inaugurating a series of ice ages. Although great glaciers moved southward from the poles over much of North America, they missed California. Smaller glaciers did, however, grind

down the slopes of the Sierra, sculpting out Yosemite and other valleys.

When the ice finally began to melt, only about fifteen to twenty thousand years ago, the coastline was some twenty miles west of its current location. The present-day Channel Islands in the south were still attached to the mainland, and current San Francisco Bay was an inland river valley. Herds of mammoths shared the cool, moist terrain with camels, giant ground sloths, and saber-toothed cats. Marshes and redwood forests blanketed the land. Oceans rose as the glaciers melted, and salt water again flooded coastal land. The climate grew warmer and drier, and deserts emerged in California's southern reaches. Many animals and plants became extinct or, like the redwoods, retreated to tiny ranges. The Pacific engulfed the Channel Islands, their flora and fauna beginning their evolution into species and varieties distinct from the mainland's. About 10,000 years ago, the sea approached its present shore, where it penetrated the Golden Gate and flooded the north-south valley in the Coast Range. San Francisco Bay waited another several thousand years to approach its present extent. When Native Americans first settled in that area, the bay did not exist. Their ancient villages are now buried under its waters and mud. California as we know it, with its sea cliffs, harbors, forests, grasslands, and deserts, is comparatively young—only a few thousand years old—and still forming. It is a fragile, and by no means immutable, land.

A Mosaic of Climates

As California's present landscape emerged a few thousand years ago, so did its modern climate. The climate results from the interaction of ocean currents and temperatures, air-pressure systems, westerly wind and storm patterns, and the orientation of its mountains and valleys. Most of the densely populated, low-lying areas along the coast and in interior valleys have a Mediterranean climate: moderate, subtropical, with rainy winters and dry summers. Although this climate type is rare, a few other regions are similar, including the Mediterranean region, North Africa, the Near East, and parts of Chile, Australia, and South Africa.

Geographic position, landscape, and a dominant marine influence explain the differences between California's climate and that of its neighbors. The wide California Current carries a stream of relatively cool water from the northwestern Pacific Ocean southeast along the coast. Prevailing westerly winds sweep air masses from the ocean, whose temperature



California Topography

Adapted from David Hornbeck, *California Patterns: A Geographical and Historical Atlas* (Mountain View, CA: Mayfield Publishing Co., 1983).

is relatively stable, and then over the land, cooling it in summer and warming it in winter, especially west of the Sierra Nevada.

A large high air-pressure zone called the Pacific High usually hovers about one thousand miles west of the coast. It intensifies the moderating ocean winds and regulates the flow of weather systems, as well as precipitation. In the late spring and early summer, as air and water temperatures increase, the Pacific High moves northward, forcing storms originating in the Gulf of Alaska to track across the Pacific Northwest and into the northern Great Plains. Thus from April through September most of the state is rain free. In autumn, however, the Pacific High drifts southward, opening the door to a succession of winter storms and delivering most of California's precipitation. Mountain chains, particularly the Coast Range, northwestern Siskiyou, and most significantly the Sierra Nevada, slow the storms and extract their moisture before they move east. As a result, California is better watered than its arid inland neighbors, dramatically enriching the state's water supply and other resources, as well as its plant and animal, including human, populations. Almost all of the region's precipitation falls in the winter, however. Water that does not run off quickly is stored in forest watersheds, underground basins, deep mountain snows, and, in modern times, reservoirs.

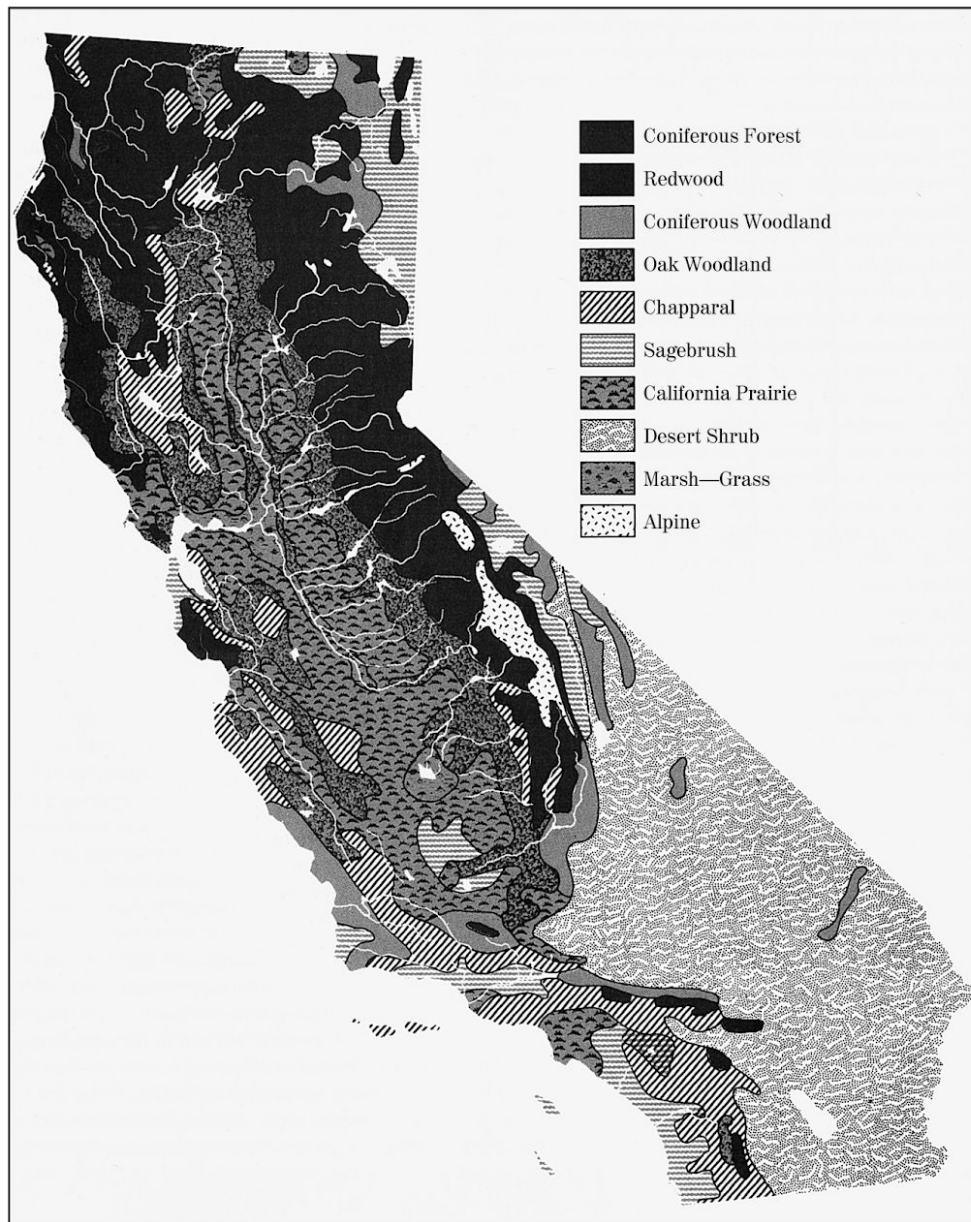
Moreover, because of its immense size and diverse topography, California encompasses a mosaic of local climates that duplicate many weather patterns elsewhere, from temperate rain forests in the northwestern part of the state, to arctic and alpine climates atop its highest mountains, to the arid steppe and desert climates of the south and southeast. The many distinct local climates vary according to four criteria: distance south from the northern border; distance east from the coast; position relative to mountain ranges; and elevation. Generally, the north is cooler in summer and wetter in winter than the south; the same equation holds between the coast and inland areas, between higher and lower elevations, and between areas west, as opposed to east, of mountain ranges. At the same time, however, low-elevation gaps in the Coast Range allow ocean air to reach some interior zones, such as inland from the Golden Gate and Carquinez Strait. In the far south, another gap in the Coast Range south of Point Conception allows ocean-moderated climates to penetrate farther east. Elsewhere, high coastal peaks inhibit the flow of marine air, casting rain shadows that reduce the land to searing deserts, as in the southern San Joaquin Valley and the southeastern Mojave and Colorado deserts.

California's climatic contrasts can be enormous, even locally. The northwest coast has one of the coolest average summer high temperatures (rarely more than 70 degrees Fahrenheit) and one of the highest average annual rainfalls (more than 100 inches) in the contiguous United States. Yet the southeast's Imperial Valley is one of the hottest and driest places in the Western Hemisphere, with summer temperatures sometimes in excess of 120 degrees and an annual rainfall of less than three inches. Some of the coldest temperatures ever measured in the United States were recorded near Donner Pass in the High Sierra (below -60 degrees), while the nation's highest temperatures (more than 130 degrees) were recorded at Death Valley, only 250 miles to the southeast. Local variations can be nearly as great. Average annual rainfall at San José is about 13 inches; at Boulder Creek in the redwood forest, 20 miles west and over the Santa Cruz Mountains, the average is 60 inches. On a hot summer day within the Los Angeles city limits, the temperature can be 75 degrees at the beaches, 85 degrees in Westwood, 95 degrees downtown, and 105 degrees in the San Fernando Valley. California's local climates—and hence its resources, plant and animal communities, and human settlement patterns—vary more than in any other land of similar size in the world.

Distinctive Plant Life

Because of its geographical location, heterogeneous landscape, and disparate climates, California enjoys unique resources. Microenvironments of distinctive location, elevation, soil, and climate nurture a more varied wildlife than elsewhere in North America. California, for example, has three times as many native plant species as the entire northeastern United States.

As befits an "island upon the land," many plants are endemic, or found only in this state. Endemic species are particularly common along the central coast, from the northern San Francisco Bay south to Point Conception; in this unique zone, cool, moist northwestern climates overlap hot, dry southwestern climates. Mountains in the north and east of the state, and deserts in the southeast, keep endemic plants from spreading and insulate them against invasion by outsiders. Indicative of California's hospitality to diverse, specialized environments and species are the state's coniferous trees. Of the 73 varieties of conifers in the American West, 54 are native to California, including about one-quarter of the world's pine species. Of the state's conifers, 21 are endemic, including the coast redwood (*Sequoia sempervirens*), giant sequoia (*Sequoiadendron giganteum*),



California Vegetation Zones

Adapted from *Historical Atlas of California*, by Warren A. Beck and Ynez D. Haase. Copyright © 1974 University of Oklahoma Press.

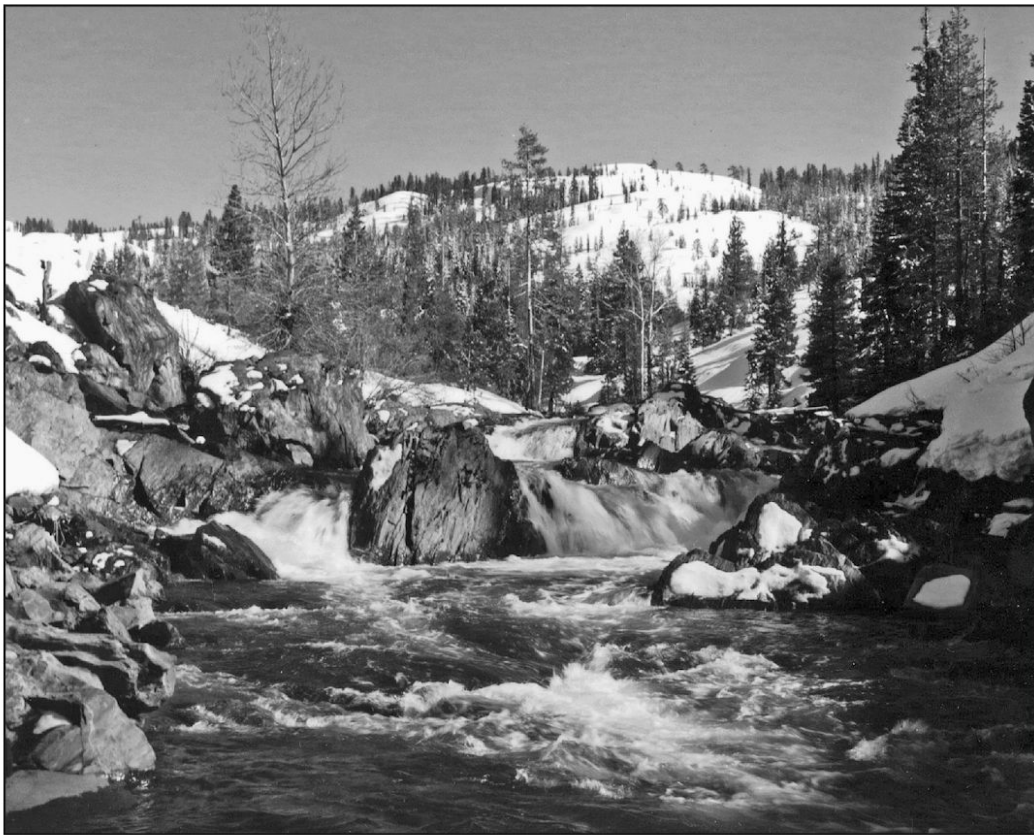
Monterey pine, gray (“digger”) pine, and many species of cypress. California gave birth to the world’s tallest species (coast redwood) and its bulkiest (giant sequoia).

Some endemic species are ancient, dating to the age of dinosaurs; today they survive only in small, specialized locales. The graceful coast redwood, though hardy within its range, depends on the cool, moist, foggy low-lying coastal belt stretching from Big Sur north to Oregon. The gnarled bristlecone pine survives only above 10,000 feet in the eastern White Mountains. Some individual trees have lived for more than 6,000 years, ranking them among the world’s oldest living organisms.

A Land of Many Worlds

California is an assemblage of small worlds, each one unique, with a combined capacity for production and self-sufficiency greater than that of most nations. The sub-regions offer an unrivaled mix of resources and economic potentials.

The state has 1,200 miles of seacoast—gentle and warm with wide beaches in the south, rugged, cold, and windswept in the north. Abundant fisheries lie in the rocky tide pools, in shoreline bays and salt marshes, and just off the coast in the nutrient-rich California Current. Before Europeans arrived, these fisheries supported



Sierra Snowpack

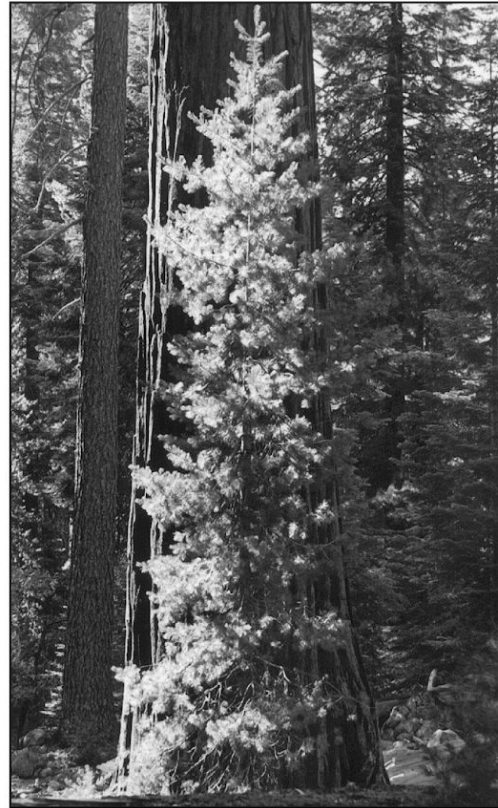
Melting Sierra snows feed the Yuba River, near Cisco Grove. Like many Sierra streams, the Yuba’s water eventually descends through reservoirs and the Sacramento River to the Delta and San Francisco Bay, slaking the thirst of farms, cities, and industries along the way. *California Department of Water Resources.*

immense populations of birds, sea mammals, and Native peoples. In the last century, salmon, cod, halibut, tuna, crab, shellfish, and, until recently, the whale supported one of the nation's largest fishing industries.

Stretching inland is a coastal plain composed of the valleys of rivers and creeks that flow into the Pacific. The coastal plain has fertile soil, moderate temperatures, and generally higher rainfall than the interior. Wide and warm in the south, the plain becomes increasingly narrow, intermittent, and forbidding until it mostly disappears in the precipitous cliffs and fog banks above Morro Bay. Natural harbors break up the plain at several points. Two, the San Francisco and San Diego bays, are among the largest and best sheltered in the world. Since the early days of European exploration, California's bays have been focal points of Pacific maritime commerce and inland transportation.

Several coastal points open to the interior. Especially important is the path through San Francisco Bay, the Carquinez Strait, and the Sacramento–San Joaquin river system, which offers the only navigable sea-level route through the Coast Range between Mexico and the Columbia River. In the days of sailing ships, this water route led to quick settlement and urban development there in the early period of American settlement. In the south, a relatively low-elevation corridor runs east from Los Angeles across southern Arizona, New Mexico, and Texas to the Mississippi Valley. Its easy grades made Los Angeles the major southwestern terminus for several nineteenth-century transcontinental railroads and twentieth-century highways. For thousands of years, the coastal valleys have supported large human populations. In modern times, they offer great potential for intensive agriculture and urbanization, particularly at San Francisco, San Diego, and Los Angeles.

California's mountains constitute another important resource. Varying from low hills to medium peaks, the Coast Range flanks the Pacific. In the north, California is separated from Oregon by the Siskiyou, Klamaths, and the southern extension of the inland Cascade volcanic range through Mount Shasta and Lassen Peak. California's most monumental chain, the Sierra Nevada, stretches southward from the Cascades in a belt 40 to 80 miles wide and 400 miles long on the state's eastern border. With many peaks over 10,000 feet, it insulates the state from the Great Basin to the east. The Tehachapis, San Gabriels, and San Bernardinos—rare east-west mountain chains collectively called the "Transverse Ranges"—slice through the state about 150 miles north of the Mexican border, dividing southern and northern California into distinct geological, biological, climatic,

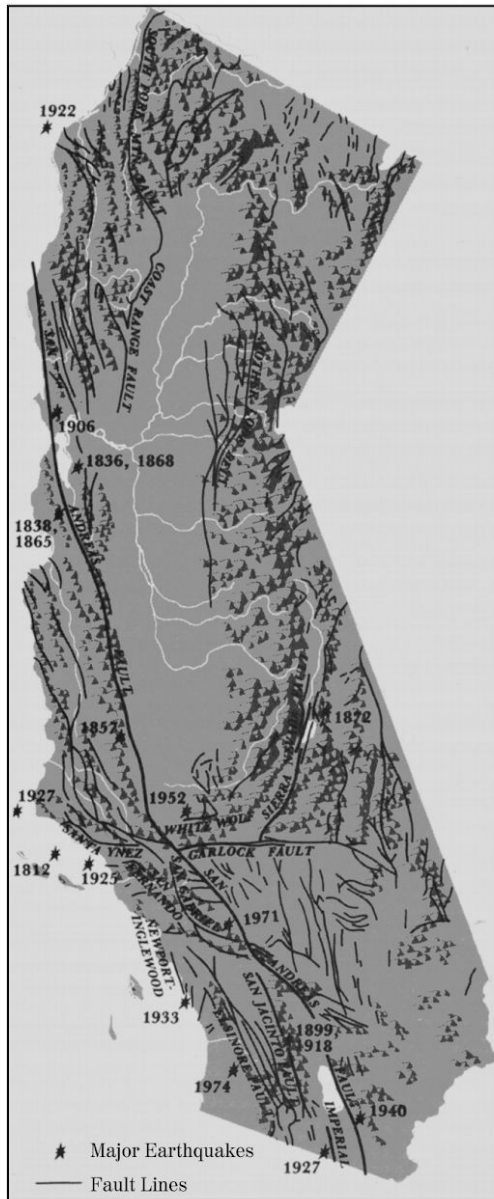


Sierra Nevada Forest, Yosemite National Park

Photograph by William A. Bullough.

and cultural regions. Its mountain chains isolate California from the rest of North America, inhibiting the migration of plants and animals to, from, and within the state. Until the modern advent of railroad, automobile, and airplane travel, these ranges deterred human immigration as well as interaction between Californians and their inland neighbors.

California's mountain ranges influence its water supply and flora and fauna, unique among the southwestern states. The north-south ranges, particularly the Sierra Nevada, directly block prevailing westerly Pacific storms, causing their air masses to rise, cool, and drop most of their abundant precipitation primarily on the western slopes, retaining most water in California and preventing it from continuing eastward. The chains themselves also serve as watersheds, storing the storm



Principal Earthquake Faults

Adapted from Robert Durrenberger, *California: Patterns on the Land* (Mountain View, CA: Mayfield Publishing Company, 1976), p. 11.

water in rocks, soils, and snows as deep as 50 to 75 feet. Then, in spring and summer thaws, water seeps and flows gradually into rivers that deliver it, as well as fertile silt, westward into the lowland valleys, sometimes directly into the ocean. In recent years, the western slopes also furnished reservoir sites for additional water storage, as well as hydroelectric power generation.

The state's mountains also house mineral treasures. More than 100 million years ago, while subterranean rocks were heating and cooling, molten gold collected in their faults and fractures. After the Sierra Nevada rose up, the lodes yielded their yellow metal, depositing it as placer gold along riverbeds in the western foothills. Great fanfare accompanied the discovery of this gold in the 1840s and '50s, triggering the first of many population booms, as well as the state's first great industry.

In moist mountain coolness, large forests thrive—redwood along the northern coast, oak on the central and southern coast and Sierra foothills, pine and fir elsewhere. The trees shelter rodents, birds, grazers, and predators, as well as preserve the mountain watershed. The trees shade and preserve snow into the summer, and their roots solidify soils, increase water-storage capacity, slow runoff, and reduce erosion. Interspersed with rugged peaks, glacial valleys, waterfalls, and sparkling alpine lakes, the forests have attracted artists, sightseers, campers, skiers, and defenders of wilderness. Until the mid-nineteenth century, when heavy logging began, forests blanketed more than half the state. Lumbering, however, has since become a major industry in northern and Sierra counties, and forests have been stripped from the land faster than nature can regenerate them. The divergent needs of lumbering, mining, irrigation, hydroelectric generation, water export to other regions, tourism, and wilderness preservation often conflict, and California's mountains and forests have become the focus of bitter political, economic, sectional, and ideological struggles.

Dramatic as the mountains are, the great Central Valley, particularly its Delta, is in many ways California's most remarkable geographical feature. This low-elevation drainage basin of the Sacramento and San Joaquin rivers lies between the Coast Range and the Sierra Nevada. Filled deep with fertile alluvial soil washed down from surrounding mountains, the valley stretches 500 miles north to south, and from 30 to 70 miles wide. The largest expanse of flat land west of the Great Plains, the Central Valley is about the size of the states of Vermont, New Hampshire, Massachusetts, Connecticut, and Rhode Island combined. Annual rainfall varies enormously north to south, from more than 30 inches at



Delta Channel and Reclaimed Farmland

Aerial photographs from the 1960s reveal the extent to which geometric, man-made patterns dominate Delta farms behind their protective levees. Remnants of original channels and marshes are still evident in some artificial waterways. *California Department of Water Resources.*

Redding to less than seven inches at Bakersfield. Standing in the rain shadow of the Coast Range, the west side of the valley is also far more arid than the east.

Nonetheless, the Central Valley enjoys abundant water resources. Large, perennial rivers originate in the Sierra to the east, snaking slowly back and forth across the gentle country, and recharging underground water basins. Before the dams and flood-control and drainage projects of the last century, marshes covered much of the land. In especially rainy years, chains of lakes dotted the valley floor, and groundwater nearly reached the land surface. With its rich soils, flat terrain, abundant water, and hot climate, in the twentieth century, the Central Valley became the world's largest irrigated plain and the

nation's most productive farm region. In modern times, however, upriver reservoirs diverting water to other regions have greatly reduced downstream flows and groundwater levels have sunk deeper.

An important topographical feature of the valley is the Delta formed by the confluence of the Sacramento and San Joaquin river systems before they flow into San Francisco Bay and the Pacific. Serving as a natural reservoir, the Delta's channels and marshes collect and disperse about one-half of the state's water runoff. At or below sea level, the Delta is also the point at which the salt water from the bay surges on alternating daily tides, eastward, then westward, and mixes with the fresh water flowing downstream from the interior. The back and forth

cleansing action of Delta marshes and sloughs maintains the purity of the bay and much of the state's water supply. Along with the state's climate and north-south mountain ranges, the Sacramento-San Joaquin Delta is one of California's most significant natural features.

Despite its importance, the Delta's freshwater supply has become unreliable. The natural extremes of saltwater intrusion into the Delta vary enormously from day to day, season to season, and year to year. Each day the freshwater-saltwater boundary fluctuates naturally, advancing eastward on high tide, then retreating westward on the low ebb. Freshwater supplies are abundant in most rainy winters, but in seasonal summer drought, saltwater penetrates farther into the heart of the Delta. In winter, the salt-fresh water line retreats west, occasionally as far as San Francisco Bay. Annual rainfall levels also affect the Delta's freshwater/saltwater balance. During the wet year of 1974, 40 million acre-feet of freshwater flowed through the Delta. In 1977, one of the driest years on record, the flow dropped to only two million.

In the last century, enormous demands have been placed on the Delta for navigable waterways, sewer drainage, and farmland reclamation behind high levees, as well as water for nearby farms, industries, cities, and more recently for transfer to the water-starved south. Despite development, enough original marshland remains to shelter migratory water birds on the Pacific Flyway, and nearly half the state's anadromous trout, salmon, and striped bass still swim up Delta streams to reach freshwater spawning grounds. Boating, fishing, hunting, and camping are also mainstays of the local economy. Like much of California, the Delta has become a land of multiple uses.

Yet the Delta is a fragile land. All the Delta's functions require a constant outpouring of fresh water from the interior to meet the irrigation, industrial, and municipal needs of local and distant people, to scour channels and prevent siltation, to cleanse waterways and maintain their oxygen levels, but most of all to keep the salty ocean from invading from the west. Fresh water flowing from the Delta also maintains the purity of Suisun Bay, the Carquinez Strait, and San Francisco Bay. Unfortunately, diversions for upstream irrigation and freshwater exports in the last century have upset the Delta's delicate balance between salt- and freshwater. The Delta and the contradictory pressures exerted upon it have become a microcosm of twentieth century and twenty-first century California water management issues.

In stark contrast to the well-watered Delta are the fierce deserts east of the Sierra Nevada and in the southeastern corner of the state. The deserts are generally

flat terrain, broken occasionally by alkali sinks, seasonally dry rivers and creeks, and ranges of rocky hills and mountains. Though the deserts support only limited natural plant and animal life, at or beneath the surface lay deposits of gold, silver, copper, borax, lime, salt, and other minerals. Once supporting valuable mining industries, these resources have since been largely depleted. In a few areas, such as the Mojave and Colorado river valleys, fertile soil is deposited by modern streams; ancient rivers also carried productive soils to the Salton Sink, or Imperial Valley. Where outside water can be acquired, the desert's hot climate is ideal for growing winter fruits and vegetables, and such rare crops as dates and melons. When irrigation began in the early twentieth century, the Imperial Valley and the Coachella Valley just to the north housed richly productive croplands, as well as the only below-sea-level agricultural areas in North America.

Water, Flood, and Drought

In its capacity for influencing human settlement, the uneven distribution of water is the most significant feature of California's natural environment. Overall, water has usually been abundant in much of the state, compared to most of the Far West. From pre-contact days to the present, the generous water supply made resources rich and large human populations possible. Yet, California is still fundamentally a semi-arid region. It receives less than half the average annual rainfall of the South Atlantic and Gulf Coast states, and its mean water runoff per acre is a small fraction of that in states east of the Mississippi.

Complex drought patterns have always shaped California's human history. First, extreme seasonal rainfall variations are inherent in the state's Mediterranean climate and west-coast location. Thus, almost 80 percent of the state's rain falls between November and March. The period from May through September—the normal agricultural growing season—is virtually rainless. As a result, without human-engineered water developments, large-scale agriculture and urbanization are difficult or impossible, especially in some areas.

Extreme regional variations in rainfall also distort access to water. Northern and Southern California are fundamentally different water regions. In the north, the air is generally more humid, the storms more frequent and moisture-laden, and the mountains higher and better-positioned to capture and store water. Nearly 90 percent of California's moisture falls north of an imaginary east-west line just south of Monterey. Most often,

northwesterly storms expend their moisture before they reach the southern districts, making them, climatically speaking, largely desert. Where northern California more closely resembles the rain-soaked Northwest, the southern counties are more a part of the arid Southwest. Yet, because of other resources—primarily petroleum and natural gas, generally wider coastal valleys, fertile soil, gentle winter climate, and proximity to strategic pathways to the interior—the coastal strip from Santa Barbara to San Diego proved a magnet for settlers after the 1880s. Today it houses more than half the state's population, producing a thirst for water that drastically exceeds local supplies.

Ironically, regionally and sometimes statewide, water can sometimes be too abundant. During particularly fierce winter storms, and occasionally entire years of abnormally high precipitation, far more rain falls than can be naturally absorbed, evaporated, stored, or drained. Much of California is flood-prone, particularly the Central Valley and the low-lying areas along northwestern coastal rivers and southern coastal plains. Great floods sometimes overwhelm towns, farms, mines, irrigation works, transportation lines, and humans. The epic flood of winter 1861–62, for example, turned the Central Valley into a giant lake, cutting state property values in half and touching off lethal epidemics. Sacramento, the state capitol, was hit particularly hard, its riverfront downtown inundated by more than 40 inches of rain just in late December and early January. To preserve its future, the city had to raise its levees 20 feet and its downtown land and buildings 12 to 20 feet. A 1938 Los Angeles area flood inundated 300,000 acres, destroyed \$78 million in property, and killed 87 people. Heavy rains in many winters there and elsewhere, particularly 1838, 1968–1969, 1982, 1983, 1986, 1995, 1996–97, and 2016–17, unleashed massive earth slides, wiped out entire neighborhoods, killed scores of people, and made isolated islands of entire communities. In fact, Los Angeles has suffered three dozen such winter flood years over the last two centuries. Ironically, Los Angeles, though located in a semi-arid desert, is one of the most flood-endangered of major United States cities.

Nevertheless, California's prolonged, cyclical water shortages—one- to ten-year periods when northwesterly storms stay in northern latitudes and insufficient winter rain falls over part or all of the state—complicate water problems even more. Such acute, multi-year drought periods have occurred every decade or two for at least the last two centuries, often with catastrophic damage to property, crops, livestock, and human welfare, sometimes with profound historical consequences.

Strangely, for example, the great flood winter of 1861–62 was followed by nearly five years of drought, especially in southern California, bankrupting Mexican-era rancheros, speeding up their loss of livestock, land, social position, and political influence, and solidifying the state's Americanization. Even modest droughts, such as occurred recently in the mid-1970s, early-1990s, and from 2012 to 2016, have intensified squabbles over water and heightened pressures to improve water-storage and transfer facilities.

“Mega-Drought”

Many prehistoric droughts over millennia testify that California is vulnerable to even longer and more severe disruptions of its water supply. Scientific analysis of buried layers of ancient pollens and growth rings from live and dead trees, as well as relict stumps drowned under high lakes, has recorded that, for at least the last several thousand years, California and often the Southwest and beyond have experienced numerous droughts lasting many decades and as long as several centuries. One epic multi-century event in California and southwest North America began in the 800s, CE, ran for 250 years, and after a hiatus of 50 years, resumed for at least another 180 years. Over that nearly 500 year period, only one-half of the previous average precipitation fell.

Such “mega-droughts,” as they are sometimes called, have been characterized by temperature increases and major dislocations to plants and animals, as well as to human societies that relied on the unstable resource base. Water courses diminished or dried up altogether, grasses withered away, plants and trees produced fewer seeds, and plant and animal communities died off or migrated to higher, cooler, better-watered, often more northerly refuges. The changing environment forced Indigenous peoples to shift to lower-quality foods or to relocate closer to more stable ecosystems, particularly toward the coast, whose tidal and deep waters sheltered more reliable food supplies. Entire cultures declined in population and splintered into smaller family-oriented groups, now forced to fend for themselves and wander in search of new, livable homelands. Increased violence erupted between hitherto isolated settled groups now competing for the same shrinking resource base.

Drastic natural and human changes driven by mega-droughts are recorded in the archeological record, pictorial writing, legends, oral traditions, and the historical spread of language dialects. Some scholars of Aztec history, for example, have theorized that long-term drought in the 1200s, CE, forced many in the culture to

abandon a drying lake in southeastern California (perhaps an ancient lake formed by the Colorado River's terminating in the Salton Sink), and to wander across the Southwest for decades before settling on another giant lake in central Mexico. Other scholars maintain that the same mega-drought dispersed the urbanized Anasazi cliff-dwellers in the Southwest, as well as the far-away Maya of Central America.

Conversely, from the fifteenth century to about 1850, California and much of North America experienced another period of cool, moist weather known as the "Little Ice Age." Thus, in the centuries since the 1500s, while human population and water developments have been growing ever larger, California has received significantly more precipitation than had been true for thousands of years before, with the last century among the wettest in the last 7,000 years. Clearly, over the historical millennia, California cannot be said to have any dependable "average" rainfall, thus any long-term, reliable water supply, even though ever-larger numbers of people have come to depend on it.

Water Development

Since the population spurts of the 1880s, agricultural, industrial, and urban development have necessitated construction of ever-more elaborate facilities for water impoundment, storage, control, and transfer. Indeed, in recent years, questions of California water redistribution have shaped regional, state, and even national politics. During the last hundred years, California farmers, who consume about 80 percent of the state's water supplies, sank wells, built dams and canals, and transferred water—sometimes over hundreds of miles—to irrigate their crops. Cities, too, have reached far: in the early twentieth century, the burgeoning communities of the San Francisco Bay Area reached out 100 miles east to grasp the watersheds of the central Sierra Nevada (including Hetch Hetchy Valley in Yosemite National Park), damming its rivers, and re-routing water supplies via canal and conduit. Simultaneously, booming Los Angeles looked 200 miles north to the eastern Sierra's Owens River Valley, acquired its water rights and, despite opposition by the valley's farmers and townspeople, imported virtually its entire river, tributaries, and groundwater by aqueduct. When severe drought returned in the 1920s, southern cities again looked outward, this time challenging six states to import the silty waters of the Colorado River. Development in post-1940s southern California consumed even these supplies, prompting southerners to turn to state and

federal agencies for help in tapping northern watersheds in the Delta, through the southern San Joaquin Valley and over the Tehachapis. South-state water visionaries have hatched yet more ambitious future contingency plans to import water from as far away as the Mississippi Valley, Great Lakes, and Canada's Yukon River.

By the 1980s, the California water-distribution system had evolved into a maze of dams, canals, reservoirs, pipelines, pumping plants, underground storage basins, and flood-control systems. Except for a handful of "wild" north-coast rivers, virtually every major stream from Mexico to Oregon was reduced to an artificial, human-managed waterway, broken by reservoirs, pumping stations, and hydroelectric generation facilities, or forced into earthen, rock, or concrete channels. In some cases, the flow of rivers has actually been forced underground or reversed, moving water in directions nature never intended. The California water system ranks among the greatest accomplishments of human intelligence, organization, and technology, but the achievement is fraught with collateral environmental damage and potential for human dislocation and controversy.

Complex water development shapes California's history and future in countless ways. In the process of encouraging economic and population growth in some areas, large-scale water transfers have also made economic development expensive, limited the growth of areas losing water, aggravated environmental problems at points of origin as well as delivery, and provoked disagreements between urban and rural areas, as well as among the state's regions, other states, and the federal government. Water development has shaped even the state's institutional structure: building and managing such massive systems has produced a seemingly impenetrable labyrinth of contradictory water laws and overlapping water agencies, and has increased the power of state and federal government to regulate vital local interests. The great expense of irrigation and land reclamation has tended to favor larger over smaller farms, wealthier growers above poorer ones, and commercial and specialized interests over those preferring localized, diversified production. In the last century, water has become California's major political, economic, and ideological battleground. Historian Donald Worster has described California as a classic "hydraulic" civilization, like ancient Mesopotamia and Egypt—centralized, hierarchical, dependent on its water facilities, and vulnerable to severe disorder should they collapse. In light of the western region's history of severe mega-drought, that dependence on artificial water systems has become even more tenuous. "We continue to run California as if the

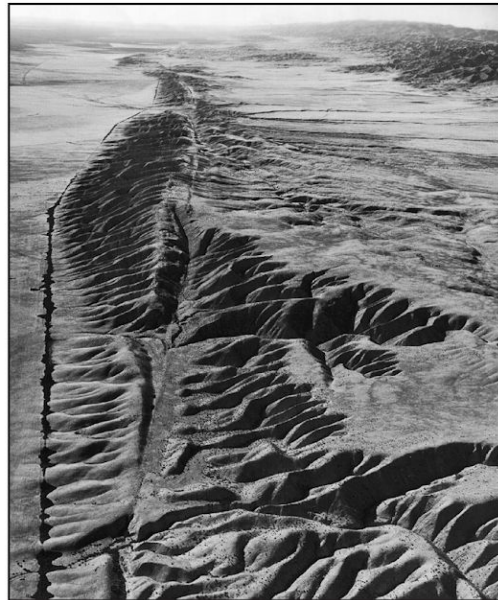
longest drought we are ever going to encounter is about seven years," has warned pioneering historical climate scientist and California State University East Bay geographer Scott Stine. "We are living in a dream world."

Environment and History

California's natural environment so dramatically differs from that of the rest of North America that observers often rely on it to explain the state's distinctive history. But several widely shared fallacies about the interaction of environment and history have clouded even scholarly perceptions. Popular and professional writers commonly celebrate the legacy of California's environment as if it were uniformly positive. Like Garcí Ordoñez de Montalvo, many describe California as "very close to . . . the Terrestrial Paradise," or as the State Department of Parks put it, a "land blessed by nature." Topography, climate, and location are frequently offered as the most powerful forces shaping the state's development, responsible for everything from moral values and religious beliefs to land-tenure patterns, from politics and literature to architecture and clothing styles.

This distinctive natural environment influenced pliable human cultures, some have asserted, and caused California to develop values and ways of life as unique as its plant forms. "The regional consciousness of California," wrote geographer James Parsons decades ago, "has had its origins in the common problems and interests imposed by geography." Isolation and climate, he maintained, "strongly influenced the settlement history of the state and the character of its economy and culture." Geography, Parsons concluded, "has had obvious and far-reaching importance for agriculture, industry, and the entire mode of life within the state . . . [and] helps account for whatever quality of regional identity, of uniqueness, that here exists."

Such theories contain kernels of truth. Certainly environment has influenced the state's history. Nature provided a general framework, creating potentials and limitations and opening directions for human activities. Because the area's resources are abundant and diverse, California has nurtured populous, complex, and successful civilizations for thousands of years. Without modifying their environments to any extreme degree, early peoples hunted and gathered abundant natural resources, living more affluently than many Native groups elsewhere. In the past 200 years, later waves of immigrants imported or created technologies and organizations to harvest these and other resources—land, harbors, grass, animals, minerals, timber, water,



The San Andreas Fault at the Edge of the Carrizo Plain

In this view looking south along the San Andreas Fault in the Carrizo Plain area, between Bakersfield and San Luis Obispo, offset streambeds illustrate the northward drift of the western (Pacific) plate. At this point along California's major fault line, single earthquakes have been known to cause the ground to leap as much as 30 feet laterally in only a few seconds, sending out destructive shock waves for hundreds of miles. *Robert Wallace/U.S. Geological Survey.*

petroleum and natural gas—even more efficiently and profitably. Each resource has given birth to thriving industries and settlements. On the basis of a prolific and distinctive natural endowment, by the twenty-first century, Californians have built their state into the most populous, diverse, productive, and wealthiest region in the Americas. Many would agree that California's history is largely a success story, a testimonial to the capacity of human intelligence to exploit nature's benevolence.

But the geographical-determinist interpretation of California's past and present, however tempting, is problematic. It encourages subscribers to believe that social and economic conditions in California are basically "natural," and therefore inevitable and immutable, blinding them to the existence of real problems, and paralyzing the development of alternative public policies.

Although it is remarkable, California is not a paradise on earth. Nature places severe limits on the aspirations of Californians, generates many of their thorniest problems, and periodically undoes much of their handiwork. In an earlier era, nature furnished bountiful foods for Indians in their island world, willing as they were to spread their populations thin, adapt to conditions as they found them, and to be content with a subsistence economy. For those who would follow, however, the land raised substantial obstacles. Geographical isolation imposed by mountains, deserts, winds, and ocean currents complicated exploration, delayed settlement and development of resources, undermined administration, and retarded the establishment of outside markets for the region's products. Diverse climates and resources, in tandem with internal natural barriers, bred local economies and communities with divergent interests, interrupted communication, and wracked the state with interregional conflicts. Internal secessionist movements, for example, have plagued California more than any other state.

Although usually present in sufficient quantity, the region's resources have proven difficult to exploit. This is especially true of water. Invariably, modern people have wanted to live and work in places where water is in short supply. Imbalances between water supply and human demands have made both agriculture and industry riskier. Like the state's minerals, forests, and soils, water could be used only with technologies that inflicted great environmental damage. Massive relocation of water has destroyed some thriving natural communities, polluted others, poisoned soils, overwhelmed drainage systems, and caused land to sink permanently. These and many other problems caused by environmental manipulation are complex and difficult to resolve, and they jeopardize present and future prosperity.

California's environmental balances are fragile and easily upset, but even the land itself is threatening. It is still under construction and ever-changing, wielding natural forces that remain potent, unpredictable, and perhaps less reliable in the future. The region is more prone than others to natural calamity—earthquakes, droughts, floods, volcanic eruptions, wild-lands fires, and tidal waves. If Californians have been blessed by nature, they have also been cursed.

Nature alone, moreover, cannot sufficiently explain California's human history. Lines of cultural development were not predetermined by natural conditions. Nature offered many alternatives. In all periods, there was wide latitude for Californians to shape their own destinies, through individual and social choices based

on values, institutions, technologies, and economic preferences. In fact, successive groups of Californians, for good or ill, have drawn on their cultures to modify the environment according to their needs, a phenomenon that has grown apace with technological development. If there were to be a single interpretation of the state's long and contradictory history, it would not be the power of nature to mold a distinctive, indigenous culture, but rather the expanding ability of humans, for good or ill, to impose their culture on the environment.

By overplaying the supremacy of nature and underplaying the resilience of culture, geographical determinists consistently exaggerate California's separateness. Often asserted but rarely proven, "uniqueness" has become an assumed California attribute. Although the region may be legitimately considered "a land apart," California's peoples at most times and in most important ways have resembled and reproduced the larger cultures to which they belonged. The state's first peoples, whose societies evolved here over thousands of years and who came closest to living the geographic determinist model, closely resembled other hunter-gatherer societies, especially other western groups. Yet, as agriculturalists and controlled burners, even they exerted a measure of control and modified their environments. After 1769, Hispanic California was but one segment of a long colonial frontier stretching across northern Mexico, sharing in broader Spanish colonial goals regarding culture, economy, and institutions. Similarly, following American conquest in the 1840s, California's rapid development and modernization is best understood in terms of that nation's culture, not as a radical departure from it.

California Before Europeans Came

The California of today little resembles the pre-European natural world. The plants, the animals, the climate, the people, and even the shape of the land have all radically changed. California now is the farm, the strip mine, the clear-cut forest, the reservoir, the suburb, the business park, the freeway, the parking lot, the information infrastructure. But before Spaniards began colonizing in 1769, a scant four or five human lifetimes ago, California's rivers ran freely to the ocean. Valleys and hills were studded with oak groves and carpeted with chest-high bunch grasses that, for the most part, no longer survive. Millions of acres of fresh- and salt-water marshes bordered rivers and bays, particularly in the Delta. Large bodies of water such as Tulare Lake, then second in size only to Lake Tahoe, dotted the San

Joaquin and other valleys. Their bottoms now pumped dry by water diversions, old lakebeds raise alfalfa and cotton. Redwood forests covered the western slopes of the Coast Range north of Big Sur, including many of the hills ringing San Francisco Bay. More than 90 percent of these virgin groves have since been cut down. Whales, seals, and otters shared the sites of present-day seaports with hundreds of millions of gulls, egrets, herons, pelicans, and migratory waterfowl. Condors and eagles ruled the sky.

Grizzlies, not humans, sat at the top of the food chain. Ten thousand of the aggressive, powerful bears roamed California in packs. They ate meat from beached whales, salmon from the rivers, and acorns from the oak trees. Fearing no other beasts, they intimidated mountain lions and humans into surrendering their kills. Webs of grizzly trails crisscrossed the state, intersecting human pathways, but Indians wisely avoided them. The world was different then, as was the place of humans in it.