diversion of the Mokelumne River; however, the impact is of a greater magnitude. Control of the watershed of the Los Angeles River had sustained Los Angeles in its youth. However, by the end of the nineteenth century, Los Angeles had nearly exhausted its ability to extract more water (Gumprecht 1999, 41–81, 83–129). To sustain growth and prosperity, the city tapped the streams and ground water from the Owens and Mono Basins far to the north by constructing the Los Angeles Aqueduct. This storage and conveyance system is half again as long and delivers nearly six times as much water as San Francisco's Hetch Hetchy project. The landscape impacts in the areas of extraction and consumption are far greater as well (Kahrl et al. 1978, 31).

The aqueduct allowed the population of Los Angeles to increase twelve fold and expand in area ten fold between 1900 and 1930 (Kahrl 1976, 115). Like their counterparts in Northern California, the storage and conveyance facilities have spawned bountiful recreational and commercial landscapes (Benchmark Maps 1998, 19, 23, 25). However, the consequences of urban water extraction have inflicted unparalleled changes on pre-aqueduct environments. Due to the Los Angeles diversion, Owens Lake is completely drained and Mono Lake severely depleted. The exposed lakebeds and shorelines are disconcertingly dramatic, and the sky over the southern Owens Valley is now turbid with dust. Moreover, the modification and elimination of riparian vegetation in the Owens Valley and along the former courses of Mono Basin's diverted streams are notable byproducts of the aqueduct system (Gaines and DeDecker 1982; Reisner 1993, 101). The Los Angeles Department of Water and Power (DWP) exercises jurisdiction over 300,000 acres of land in Owens Valley and continues to curtail urban expansion around settlements such as Bishop and condone the deliberate removal of numerous rural farmsteads. Furthermore, the fields of irrigated crops that once carpeted the valley have been rendered into scrublands and pasture (Hart 1996).

Unbridled urban expansion in Los Angeles and other cities in southern California immediately prior to and following World War II created the need to import additional water from the north by the California Aqueduct and from the east by the Colorado River Aqueduct. Although the majority of the water is utilized for irrigation elsewhere, the Colorado River serves water to over fourteen million people inhabiting 300 cities spread over 5000 square miles (Selby 2000, 199). As a consequence of this fresh abundance of imported water, Los Angeles doubled its population again between 1940 and 1970 (Kahrl et al. 1978, 42). Furthermore, its neighboring cities stretching from Ventura to San Diego have expanded even faster, sustaining rapid growth into the twenty-first century.

Many settlements in California require varying amounts of fresh water from subterranean sources. However, interbasin water transfers have supported most of the state's urban expansion and sustained a booming economy. Indeed, cities over large areas of the state have benefited from water projects that were constructed primarily for agricultural purposes such as the Central Valley Project. Since San Francisco's fateful diversion of Lobos Creek in September 1858, California cities have contributed heavily to the construction of over 1300 dams and associated facilities currently scattered throughout the state (Selby 2000, 194, 203, 209). This reciprocal relationship between cities and water is a driving force behind the state's continuing population explosion and the expansion of its urban landscapes.

Creation of Suburbs, 1864

Most of California's 34 million people live in suburbs, and the resulting landscapes have fundamentally refashioned the visible scene. The state's most extensive suburban landscapes ring Los Angeles, San Francisco, and San Diego where the vast majority (70–80 percent) of the urban population lives beyond the boundaries of the central city (Kenworthy and Laube 1999). Similar sprawling collections of dispersed housing, two-car garages, backyard patios, commercial strips, and shopping malls can also be found from El Centro to Redding. Much of today's suburban landscape has been created since 1950, although the roots of California's suburbs extend well back into the nineteenth century. The penchant for escaping central cities was already apparent in the vicinity of New York City as early as 1810 (Brooklyn Heights) (Jackson 1985, 25–30). In California, the 1864 completion of a rail line from San Francisco to San Jose spawned the first generation of suburbs (Burns 1977, 1980). Bay Area elite were attracted to the pastoral lifestyles and low density housing of planned suburbs such as Burlingame and Atherton. It was the beginning of a landscape-shaping process that continues unabated almost 150 years later.

California's suburbs have enduringly altered earlier landscapes. Where suburbs have sprouted in valley settings, they have often consumed huge tracts of agricultural land. Indeed, over 25 percent of the state's best soils are now covered by urban or suburban land uses. For example, Los Angeles County lost over 45,000 acres of citrus land to suburban growth in the ten years following World War II (Nelson 1959, 80; Banham 1971, 161–77). As suburbs multiply, suburbanites bring in thousands of exotic trees, plant extensive lawns, displace native animals with their suburban pets, and forever alter the fundamental ecological setting (Price 1959; Streatfield 1977). Foothill environments, including many around the Bay Area as well as inland Southern Cali-

fornia, have also been dramatically altered by suburban growth (Banham 1971, 95–109). Natural vegetation has been encroached upon, and drainage and topography have been reconfigured to suit the needs of the California hill-dweller. Frequently, such settings are also the scene for fire and flood damage, a reminder that the natural landscape is not infinitely malleable to meet human needs.

Why are suburbs where they are on the California landscape? Dozens of suburbs owe their origins to the geography of nineteenth-century interurban rail lines that radiated from major cities such as San Francisco and Los Angeles. Indeed, southern California boasted over 1100 miles of rail network and these links encouraged suburban growth in places such as the San Fernando Valley, Pomona, and Anaheim (Bottles 1987). Other suburbs popped up near industrial activity that sprouted beyond the boundaries of traditional cities (Hise 1997; Matthews 1999; Viehe 1981). For example, Brea and Fullerton appeared near oil fields, Burbank grew in response to the movie and aerospace businesses, and San Jose benefited greatly from high-technology industries in Silicon Valley. Real estate promoters have also shaped the growth of the suburban landscape. Southern California's real estate boom of the late 1880s produced more than 60 new suburbs. While some vanished, communities such as Glendale, Monrovia, and Redondo Beach owe their origins to such activity (Nelson 1959; Streatfield 1977a). Throughout the state, however, the automobile and its associated road network have undoubtedly exercised the greatest influence on the location and spatial extent of California's suburban landscape (Foster 1975; Meinig 1979). Between 1920 and 1950, the automobile's flexibility encouraged the infilling of open space between older discrete, suburban communities on the edge of major cities. Since 1950, powered by spreading freeway construction, the automobile has enabled much more suburban growth often 40 to 60 miles or more from the central city (Figure 6). Today, Tracy and Manteca have become Bay Area suburbs, while Temecula and Moreno Valley are within the ever-spreading reach of Los Angeles (McIntire 1998, 44–49).

A surprising variety of settlement patterns and street layouts are associated with California's suburban landscape (Palen 1995). The curving streets, abundant foliage, and large lots of the state's elite suburbs form one enduring settlement model (Burns 1980; Jackson 1985, 178–81; Streatfield 1977b). Boasting social and spatial exclusivity as well as an abundance of environmental amenities, settings such as Hillsborough (near San Francisco), Montecito (Santa Barbara), and Beverly Hills (Los Angeles) illustrate the pattern. Indeed, Palos Verdes, a seaside elite suburb near Los Angeles, was the carefully planned brainchild of landscape architect Frederick Law Olmsted. Another common suburban settlement

pattern is the repetitive grid of cardinally oriented streets, rectangular lots, and mass-produced single-family housing. This distinctive settlement pattern expanded greatly after World War II as pent up demand for housing, a new scale of real estate and building promotion, and an accommodating federal government (FHA loans and the GI Bill) spurred

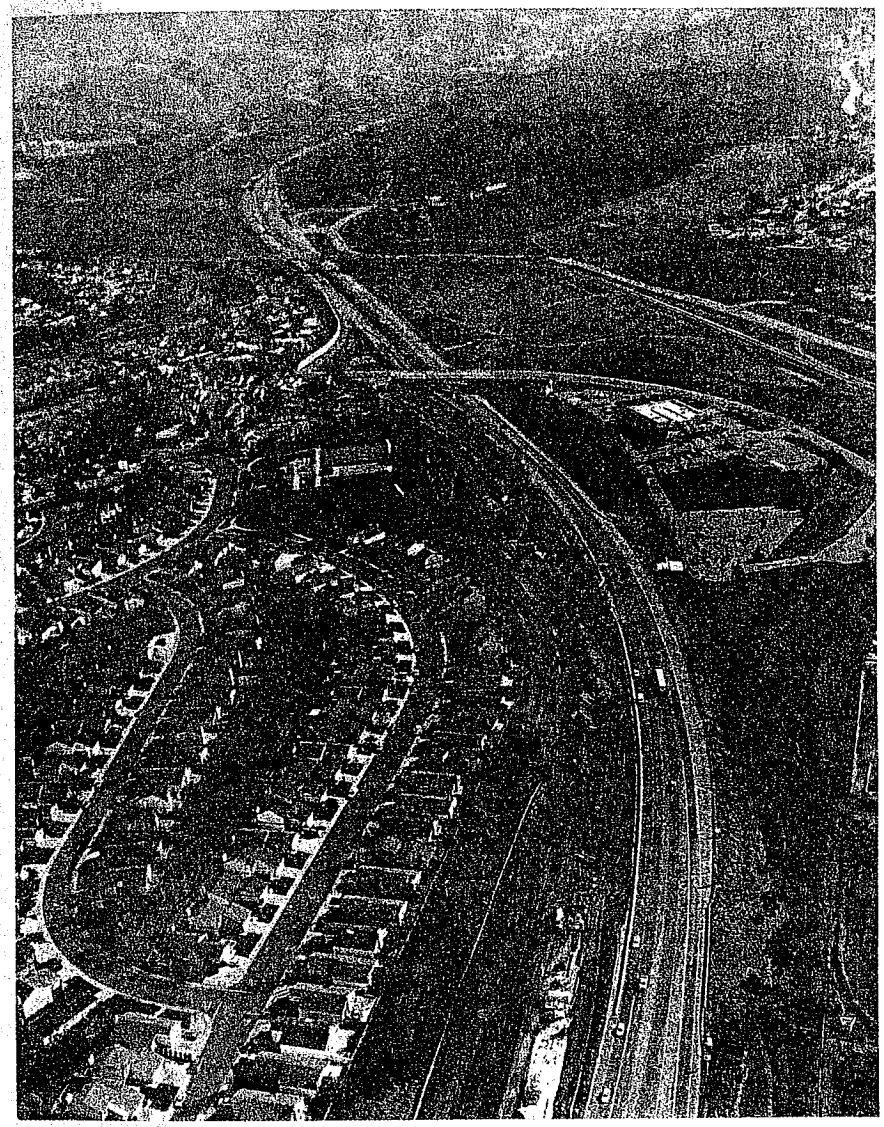

Figure 6.
Suburban sprawl clinging to Interstate 680 in Contra Costa County.
Photograph provided by California Department of Transportation.

home construction. The 1950s and 1960s witnessed large development projects in such localities as Lakewood Village south of Los Angeles and Daly City and Foster City near San Francisco (Banham 1971; Burns 1977; Price 1959). Many of California's suburbs, however, have sprouted since 1970, and these developments have featured more eclectic settlement patterns. Some have been shaped by large-scale coordinated planning (Mission Viejo) of street layouts and land use, while others (San Bernardino and San Jose) offer a varied, spatially extensive collection of street plans and population densities, often depending on income levels, local topography, and the tastes of developers (Abbott 1993, 123–48; Kling, Olin, and Poster 1991) (Figure 7). Some feature the familiar grid, but many subdivisions also offer curvilinear layouts, cul de sacs, and a greater mix of single and multiple-family units.

Suburban architecture is similarly varied. Residential districts reflect different preferred building styles, depending on income and age of home construction (Abbott 1993, 123–48; Banham 1971; Meinig 1979; Rubin 1977). Bungalow-style housing, for example, signifies a neighborhood usually created between 1900 and 1925. Single-story ranch-style housing tracts multiplied in the 1950s and 1960s, covering many additional square miles of the California landscape. Elsewhere, higher density suburbs suggest that rising land costs and changing lifestyles of the past thirty years have created more demand for apartment, condominium, and townhouse living.

Added to this increasingly diverse accumulation of residential architecture are the varied commercial, retailing, and industrial landscapes that shape the suburban scene today (Banham 1971; Bottles 1987; Preston 1971; Longstreth 1997). Commercial strips and suburban shopping malls create a landscape that is mass-produced, franchised, and packaged to meet every need of the California consumer. Newer suburban complexes, such as those in Orange County and Silicon Valley, also offer an ever-growing variety of land uses that is creating a new landscape some have even described as "postsuburban." Perhaps signaling a common American future, these places are characterized by multiple regional-scale shopping malls, entertainment complexes, a mix of office parks and space-extensive industrial facilities (often oriented to the global information economy), a bewildering network of freeways and multilane surface streets, and a residential landscape, with both single- and multiple-family housing, oriented around convenience, consumption, and personal privacy (Kling, Olin, and Poster 1991). As with so many other elements of the California landscape, these features have created a visible scene already being widely replicated far beyond the bounds of the Golden State.

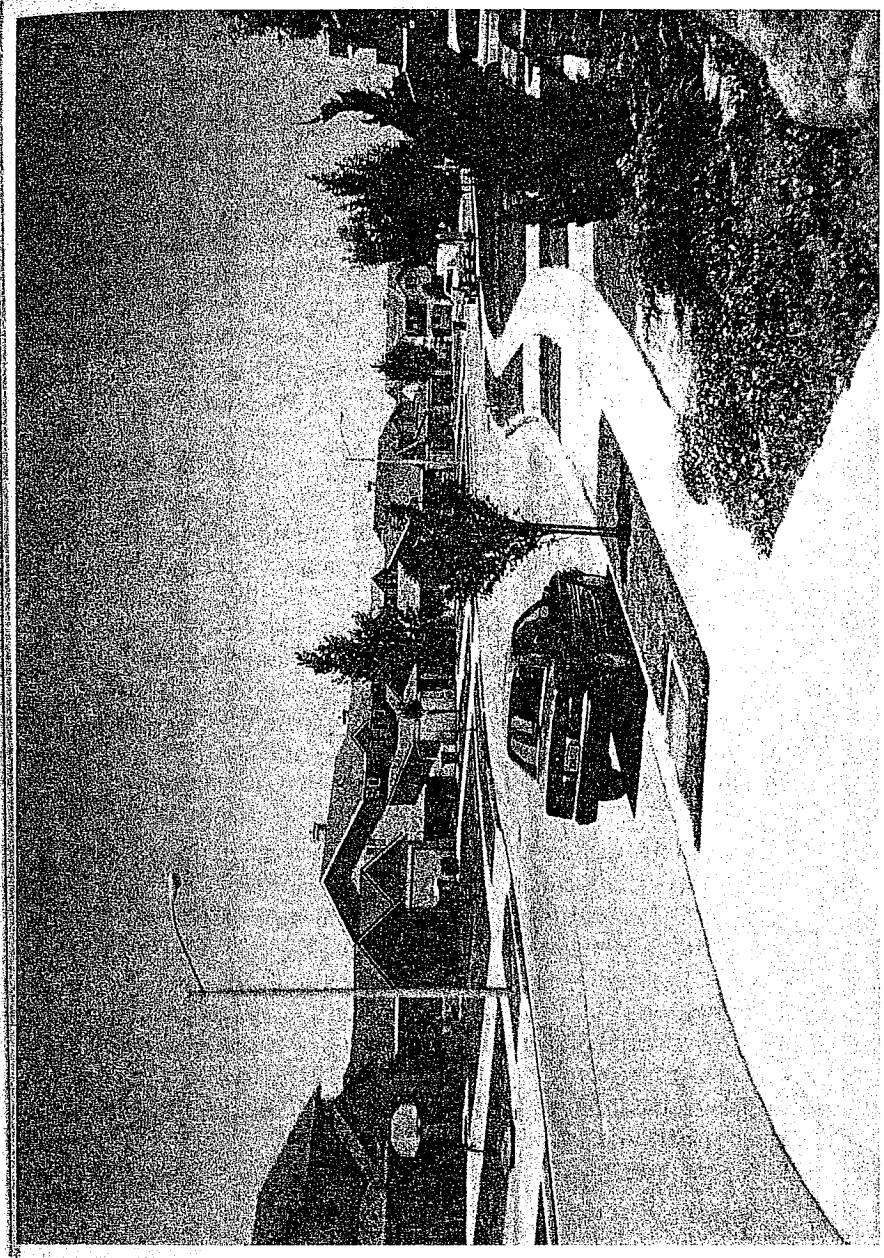

Figure 7.
The expansive and repetitive landscape of the California suburb is exemplified by this tract in Lemoore.

Photograph by W. Preston

Yosemite State (and National) Park, June 30, 1864

In 1864, the literate American public felt disgust over the privatization and tawdry development at Niagara Falls. When it appeared the same would befall Yosemite Valley and the Mariposa Grove, Congress set them apart as a public park for California (13 Stat. 325). Eight years later, lacking a state to receive land, another Congress established Yellowstone National Park. Yosemite, however, was the groundbreaker, the nation's first state and, in reality, national park. A year after its creation, Frederick Law Olmsted laid out a management prescription that would become the blueprint and the philosophy for park systems nationwide (Olmsted 1865). A half-century later the Yosemite grant returned to federal management while the state pursued redwood lands for new parks (Engbeck 1980).

Today California boasts the largest and most diverse state park system in the country. It also has more units of the national park system than any other state except Alaska. Twenty-three national park units, totaling 8.1 million acres and 265 state parks at 1.4 million acres comprise more than nine percent of the state's land area (Figure 8). Together they serve nearly 120 million visitors per year (California State parks Foundation 2000; National Park Service 1997). Every ecological division and a bewildering array of historic themes are represented. The impact of these many preserved places on the landscape of California results not only from what they have wrought but what they have stopped.

The most important impacts of the parks have been preservation of open space and prevention of development. Golden Gate and Santa Monica National Recreation Areas and numerous state parks have checked residential sprawl in the state's major urban zones. Torrey Pines, Los Osos Oaks, Crystal Cove, Topanga Canyon, and Mount Diablo are among the state units with subdivisions lapping at their borders (Figure 9). Point Reyes National Seashore halted a major tract development after roads and twelve houses had been built. The area of the planned suburb now sweeps down to Limantour Spit with only three employee houses in view (Duddleson 1971; Pozzi 2000).

The presence of a park also has blocked other types of development. After San Francisco built Hetch Hetchy Dam in Yosemite, Congress, in 1921, enacted an amendment to the Federal Power Act forbidding its implementation in national parks (41 Stat. 1353). In the case of the Kings River, Congress blocked a Los Angeles reclamation project by adding the area to Kings Canyon National Park. The National Park Service (NPS) and park supporters also blocked several trans-Sierra road projects, losing only at Tioga Pass. An ambitious plan to build a high elevation road

along the entire Sierra Nevada also failed due to NPS opposition (Dilsaver and Tweed 1990, 182–186).

Arguably the most important open space preserved by the parks is along California's crowded coast. The California state park system holds title to 280 miles, or 25 percent, of the shoreline. National parks account for nearly 100 miles more, not including the Channel Islands. Although all open space is important, more than a fourth of California's parklands are designated wilderness. Here the controls on construction and use of mechanical transport promote a more complete natural signature on the land (Schaub 2000).

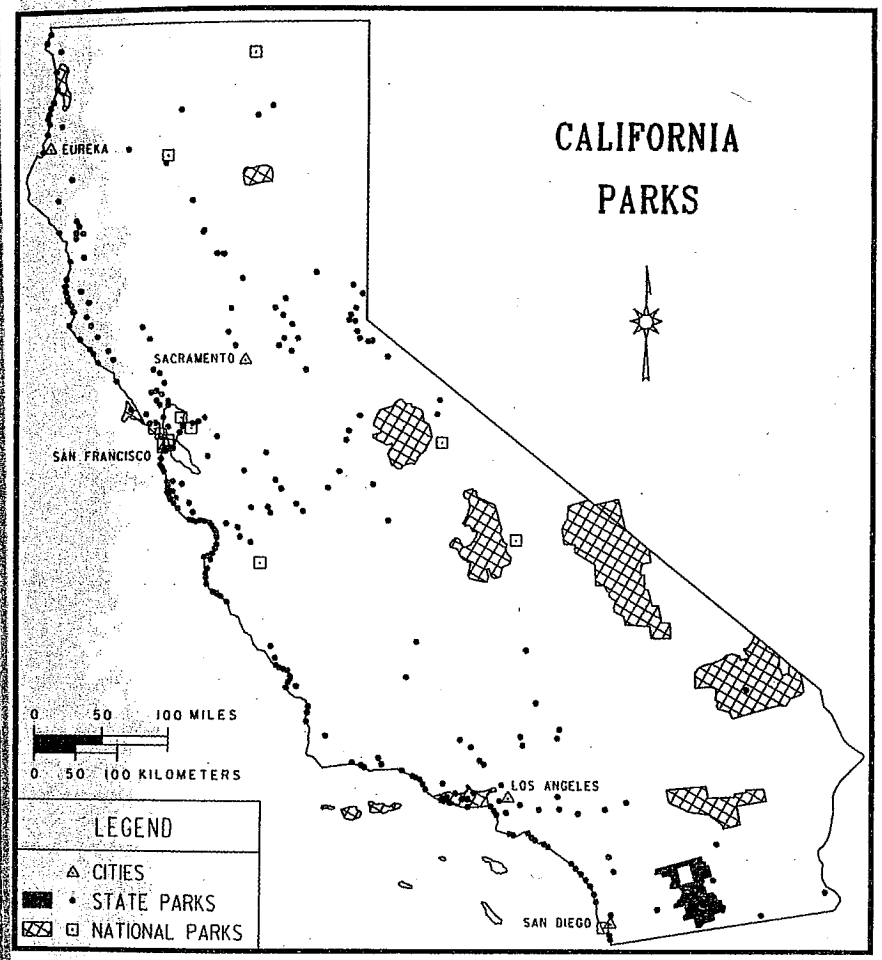

Figure 8.
National and state parklands in California. Sources: California State Parks and National Park Service.
Cartography by Margarita M. Pindak.

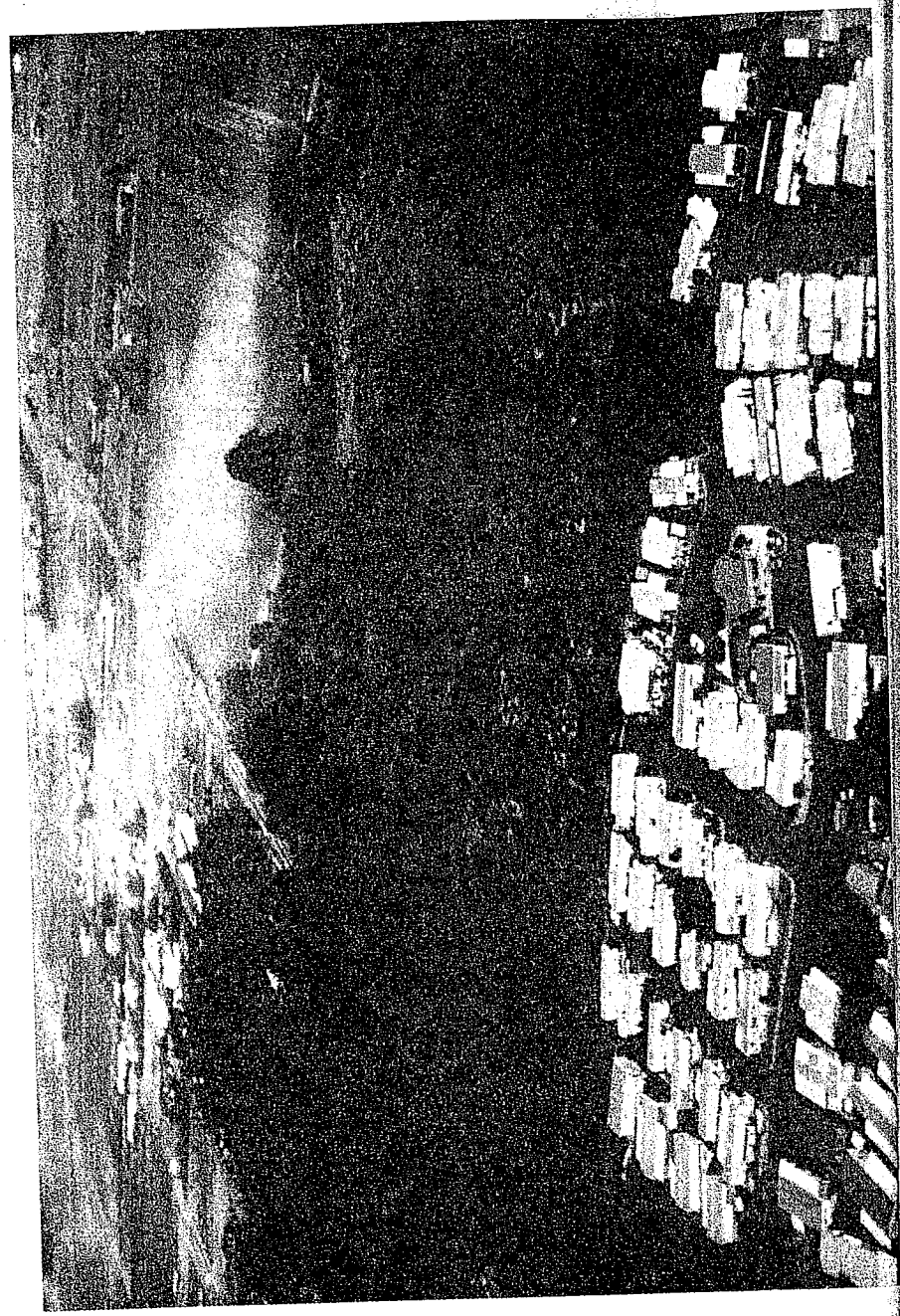

Figure 9.
Los Osos Oaks State Park near San Luis Obispo protects an island of nature amid residential and agricultural development.
Photograph provided by the Photographic Archives of California State Parks.

Despite the preservation of open space, the legacy of human activity is present in all 288 park units. Park management has actively altered ecosystems while at the same time causing them to diverge markedly from the lands surrounding them. Among park managers' early steps were, first, enjoinment of lumbering, hunting, and most grazing and, second, suppression of fire. Parks contain many areas of old-growth forest coveted by loggers. Originally, California boasted nearly two million acres of redwood groves. Only 86,000 acres remain, 93 percent of them in parks and reserves (Redwood National Park 2000).

Rangers practiced extensive fire suppression prior to the mid-1960s. During that time forest composition altered, sometimes dramatically, especially in the mountains. For example, giant sequoias simply did not regenerate for nearly a century. In the process, species like white fir expanded in both range and density of coverage among the sequoia groves (Sequoia and Kings Canyon 1987). During that time the fuel load in forests built up to an unnatural level that has rendered prescription burning a feeble corrective device.

Park management of fauna has also impacted the landscape. Early efforts to eliminate predators, coupled with bans on hunting, led to eruptions in ungulate populations. Deer in particular wreaked a devastating impact on vegetation. The chain reaction of these ecological changes rippled through communities contributing to near elimination of some species and increases in others. Subsequent efforts to protect predators, especially black bear and mountain lions, have led to the further divergence of parkland ecology from the surrounding areas. Bears, the aforementioned ecosystem engineers, are densest in the large parks where hunting is forbidden.

Another impact of the national and state parks is in preservation of historic structures and landscapes. Indian settlement sites, Spanish missions, forts of various groups, and agricultural, industrial, commercial, and even Hollywood landscapes are preserved. Many ethnic landscapes have persisted due to their inclusion in park zones or to financial support from the state or national parks. The preservation movement, begun at Yosemite, led to the 1906 Antiquities Act (34 Stat. 225) for protection of historic resources. Ironically, President Clinton recently used it to protect the offshore rocks and islands along California's entire coastline (US Department of Interior 2000).

Within the parks' auto-accessible zones, planners design buildings and landscapes to exacting specifications and styles. This "parkitecture" is duplicated throughout both systems as well as various regional and local parks. Planners design campgrounds, buildings, parking areas, and

the disguised infrastructure to support them to have a "rustic" look that is both carefully wrought and itself historic (Carr 1998). Still another influence of the parks extends beyond their boundaries. Most national and state parks are major recreation destinations. The road system has evolved to cope with traffic coming to internationally significant sites like Yosemite and Sequoia, as well as the many accessible beach parks. Gateway towns such as El Portal, Mariposa, Three Rivers, and Borrego Springs have their own landscapes of tourism–lodgings, dining establishments, souvenir shops, and a remarkable array of loosely associated amusements. Parks in urban zones, with their protected open space, increase the value of adjacent lands. This, in turn, often leads to more expensive residential and commercial development. Also, parks and their tourism provide economic multiplier effects that spawn additional development in surrounding regions.

Finally, among the subtlest influences of the national and state parks is their contribution to environmental education and conservation proselytization. Outside academia, Californians encounter the environmental message most often in their parks. In some immeasurable way the cumulative impact of this message surely influences human landscapes throughout the Golden State.

The Coming of the Transcontinental Railroad, May 10, 1869

"There has never been any sustained attack on the idea that the steam railroad was the most significant invention or innovation in the rise of an industrial society." So wrote historian Albro Martin in 1992 (12). *California History* editor Richard Orsi (2000a) is more geographically specific, labeling the railroad the most important factor in California's history and landscape. Invented in Britain, the railroad came to America when the Baltimore and Ohio Railroad Company was chartered in 1827 and became fully operational in 1830. California's first line ran from Sacramento to Folsom in 1856 (Holliday 1999, 170; Vance 1995, 25–31). However, it was completion of the transcontinental railroad on May 10, 1869 that brought a major corporate carrier, substantial land grants, and profound economic, social and geographical change to the state. Through establishment of transport routes and towns, development of land, water resources and tourism, economic impacts on mining, agriculture, and forestry, and direct formation of both the urban and rural landscape, the railroads, led by the Southern Pacific (SP), drove California into the industrial age. Today 30 railroads, most of them local, still operate on 6341 miles of track in the state. The Burlington Northern and Santa Fe and the Union Pacific, two national carriers, own the majority of the track (Association of American Railroads 2000).

The spatial array of transportation and settlement in California owes much of its pattern to railroad planning and construction. The Central Pacific line over Donner Pass bisected the Sierran mining region amidst a general and largely irreversible economic decline. It galvanized agriculture and service businesses, creating a growth corridor. Major wagon and auto roads followed, as did Interstate 80 (Dilsaver 1982, 184–190, 380–395). Elsewhere, the railroads also laid a transport network over the state. Interstate 5 in the Sacramento Valley, State Highway 99 in the San Joaquin, and large portions of I-10, I-15, and I-40 in the desert closely parallel the tracks (Figure 10).

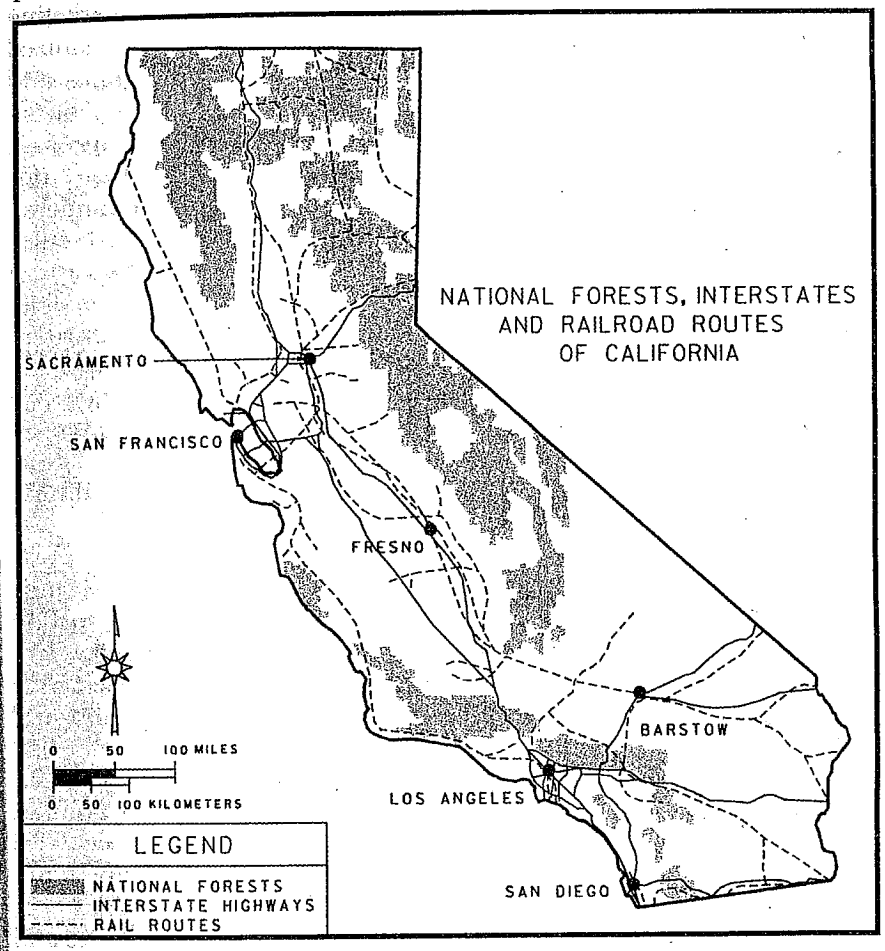

Figure 10.
National forests, railroads, and interstates (plus Highway 99) in California. The forests cover the mountainous one-fifth of the state. Many highways followed the routes of the railroads.
Cartography by Margarita M. Pindak.

Along these lifelines, the railroads established or encouraged numerous towns to serve as passenger and freight entrepots. The Central Pacific and, later, the Southern Pacific developed Lancaster and Palmdale in the Antelope Valley, Livermore and Tracy near the Bay Area, Mojave and Coachella in the desert southeast, and dozens of market centers in the San Joaquin including Modesto, Merced, Fresno, Tulare, and Hanford. Wherever the railroad built towns, businesses and farmers followed.

In order to sell their government granted land and provide customers for their trains, the railroads did everything possible to encourage settlement. The Southern Pacific operated elaborate planning and marketing departments, both relying on the latest scientific data. It also organized and bankrolled irrigation, farming cooperatives, forestry programs, and tourism development. One profound impact on California's modern landscape is the preponderance of orchards, vineyards, and horticultural fields in the state's lowlands. Although many of these crops arrived with the Spanish, farmer and customer inexperience hindered their popularity and proliferation. The Southern Pacific provided settlement assistance, crop research and education, marketing in the eastern U.S. and Europe, and the nation's largest refrigerated rail car system. The latter was particularly important with the railroad's successful program to generate cantaloupe production in the Imperial and Coachella valleys. The SP located and dug the first wells, researched the cantaloupe as both crop and popular food, built its tracks and towns in the two valleys, installed refrigeration facilities, taught farmers to grow the strange crop, and heavily marketed it in eastern cities (Rice et.al.1996, 282–283, 286–288; Orsi 2000b, Chap. 9; Orsi 1991, 51).

The railroads also exerted a strong impact on California's forested landscape. On one hand, railroads deforested some areas for construction materials and, before 1880, fuel. Additionally, narrow gauge independent or spur lines spread lumbering and mining especially in the Sierra Nevada. Yet the Southern Pacific, with its long-term planning and research programs, quickly embraced forest conservation for watershed protection. SP executives believed both agriculture and tourism revenues depended on it. The company played a significant political role in the establishment of national forests in the state and a technical one through its organization of the first effective fire suppression system. The SP also pursued a vigorous program of research, education and quarantine during the pine-rust-beetle infestation of the 1900s and 1910s (Orsi 2000b, chap. 11).

The important influence of the railroads on national parks and western tourism is well established (Rothman 1999; Runte, 1990a; Wyckoff and Dilsaver 1999). Encouragement of tourism was a source of passenger

and profit. California was no exception. Southern Pacific manipulation, much of it hidden from the public, led directly to the establishment of Sequoia, General Grant (now Kings Canyon), and Yosemite National Parks in 1890 (Dilsaver and Tweed 1990; Runte 1990b). Promotion of mountain recreation and the wilderness experience contributed to more preservation and tourism development during the ensuing thirty years. It is no overstatement to say that without the railroads' influence the wild areas of California would be quite different today.

Urban areas too were impacted by the railroads. Some cities, like Oakland, owe their form and function to them. Older industrial landscapes

Figure 11.
Oakland, like other significant California cities, has a large and impenetrable railroad yard that shapes the geography of other urban functions.
Photograph provided by California Department of Transportation.

cling to their former lifeline, often near city centers. Many are now depressed and crime-ridden neighborhoods. Planning for transportation and redevelopment in railroad cities can be a challenge. Immovable tracks and traffic congestion during train crossing force adjustments in any spatial plan (Figure 11). Yet, the sprawl of California's major urban areas owes its origins to suburban rails. With the functional, if not financial, success of Bay Area Rapid Transit (BART) and light rail systems in San Jose, Los Angeles, Sacramento, and San Diego, urban rails are becoming more prevalent after years of decline (Figure 12).

Finally, as we travel through the state, there are the remnant visual scenes at every turn. In the countryside, amid the orchards and specialty crops, grid pattern town centers orient along the tracks rather than cardinal directions. Loading facilities and silos, many abandoned, still loom beside the tracks. The rails themselves impart a linear pattern that disrupts the geometry of the Township and Range and the polymorphous natural landscape. Lines of trees, planted by the Southern Pacific for shade, wood, and adornment, can be found on former railroad lands, along tracks, and at stations extant or remembered. They include eucalyptus, tamarisk, black locust, and palms. Some abandoned railroad rights-of-way now serve as recreation trails. Overpasses and the occasional tunnel mark the intersection of the rail and auto networks (Rademacher 1999).

Entering the dense buildup of the cities a clustering of industry and warehouses follows each rail corridor. Large rail yards create impenetrable impediments to intra-urban flows of cars and people. The periodic traffic jams that accompany a passing train, added to these other impacts at all scales, demonstrate the enduring legacy of the golden spike on May 10, 1869.

Electrification of Market Street, April 9, 1874

The tiny nocturnal glow of Father Joseph Neri's electrically powered arc light along San Francisco's Market Street signaled the beginning of a new era destined to reshape the California landscape (Brechin 1999, 253–56; Williams 1997, 170). Even as early as 1890, some observers realized that the harnessing of electricity was "destined to be one of the most powerful factors entering our social condition" (Williams 1997, 168). Indeed, that was the case, and California, both then and now, led the nation in innovative applications of electricity technology that endlessly refashioned the visible scene. Californians embraced electricity as an almost mythic symbol of progress upon the landscape: every community wanted the latest electrical street lighting and trolley system, and every California household embraced the newest electrical appli-

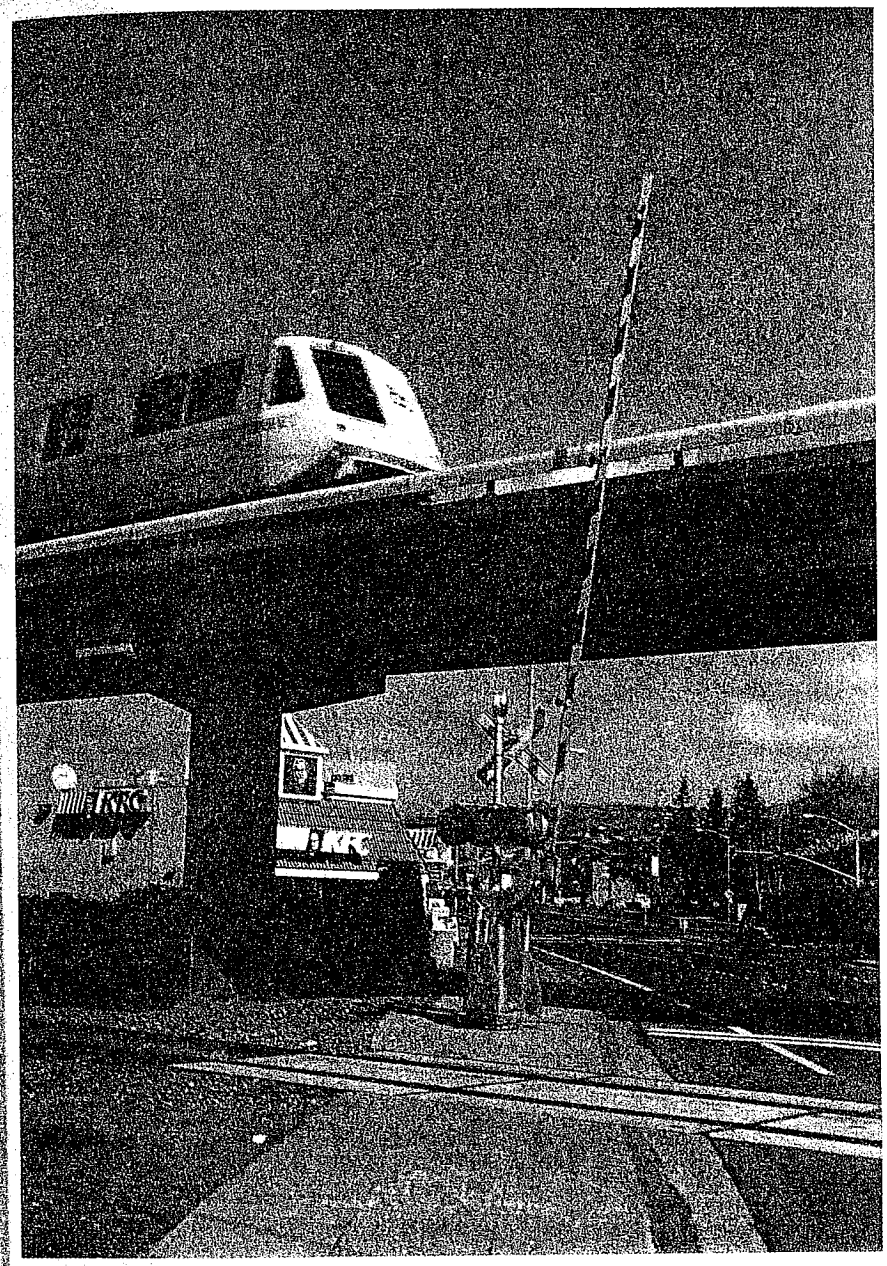

Figure 12.
The California urban landscape, seen here in San Leandro, reflects the overwhelming influences of railroads and automobiles.
Photograph by L. Dilsaver.

ance that promised to save time and money (Nye 1990, 1–2). As the demand for the new technology grew, so did the extensive infrastructure necessary to bring electricity to every corner of the state. By the early 1890s, the use of alternating current (A/C) technology allowed for the long-distance movement of electricity, a breakthrough that immensely stimulated the construction of hydroelectric power-generating facilities far from where the electricity was ultimately consumed (Brechin 1999, 255; Williams 1997, 173–77). From that point on, Californians displayed an unending thirst for power: in 1915, they consumed 2215 million kilowatt (k/w) hours of electricity; in 1950, the figure had leaped to 24,800 million k/w hours; and today the state devours more than 268,000 million k/w hours annually (California Department of Finance 1999; Williams 1997, 374).

The California landscape is filled with the infrastructure of electricity, including all of the generating facilities and transmission lines that bring the power from producer to consumer. The geography of hydroelectric power illustrates the pattern. As hydroelectricity gained in popularity with A/C technology, the state's physical geography preordained an elaborate network of long-distance connections: California's major mountain zones, the home of most of its hydroelectric-generating potential, are typically found at some distance from the state's major population clusters (Williams 1997, 169–70). The result has been the construction of an elaborate series of mountain dams and hydroelectric-generating facilities along with the development of an extensive power grid connecting these often remote sites to major zones of consumption. For example, Northern California's Shasta complex (Sacramento River) and dozens of Sierra Nevada facilities (including projects on the Pit, Feather, Yuba, Stanislaus, Tuolumne, San Joaquin, Kings, and Kern Rivers) have reshaped the state's mountain geography with a broad assortment of dams, reservoirs, and power lines. The potential for these mountain sites was demonstrated in 1901 when Oakland's streetlights and trolley cars became powered by waters from the far-off Yuba River over 140 miles away (Brigham 1998, 3). Later projects were even larger in scale: the building of the San Joaquin River's Big Creek Dam, critical in powering distant Los Angeles, involved the construction of over 56 miles of new mountain access roads, 12 work camps and construction facilities (later used for maintenance), and over 240 miles of transmission lines to the Southland (Williams 1997, 184–86). The Colorado River's federally financed Hoover Dam project also contained a critical hydroelectric component. By 1939, it was the world's largest hydroelectric facility and it allowed Southern California to increase its consumption of power thereafter (Starr 1990, 157–58; Stevens 1988, 259). Indeed, electricity figured into the rationale for building many of the public dams in the West because potential power sales were used to justify the

construction costs of such projects (Brigham 1998, 12).

Also facilitating the creation of such infrastructure (both public and private) was the emergence of large state-regulated public utility companies that represented the consolidation of many smaller operations. Pacific Gas and Electric (PG&E) formed in 1905 and still dominates electricity generation in Northern California, while Southern California Edison (SCE), consolidated in 1909 and remains central to electricity production in the southern portion of the state (Brechin 1999, 264; Coleman 1952; Starr 1990, 157; Williams 1997, 182–83).

Technological moves beyond hydroelectricity have also shaped the state's landscape. Today, only 18 percent of the state's electricity is produced by hydroelectric facilities. After 1950, new steam turbine technologies allowed for the use of fossil fuels in generating electricity and today these power plants, widely scattered across the state, provide Californians with their most important source of power (Williams 1997, 277–82). In addition, the state's nuclear power facilities in such localities as San Onofre (north of San Diego) and Diablo Canyon (near San Luis Obispo) provide an additional 15 percent of the electricity budget (California Department of Finance 1999). The largest visible imprints of so-called "alternative" energy production include local solar energy generating units (often atop individual homes), geothermal power plants (especially Sonoma County's Geysers facility), and 27,000 acres of wind-generating turbines (including Altamont Pass east of Livermore, the Tehachapi Mountains northwest of Mojave, and San Gorgonio Pass east of Banning) (California Department of Finance 1999; Williams 1997, 288–91, 330–35).

The consumption of electricity has also radically altered the California landscape. In urban settings, the initial focus of electricity consumption (in the 1880s and 1890s) came in the form of electrified streetcars and street lighting (Brigham 1998, 3; Nye 1990, 69–137). Although the streetcars have largely vanished, many of the key urban commuting routes they created remain as principal urban and suburban thoroughfares today. The modern nocturnal illumination of the city, of course, remains an enduring legacy. Californian historian Kevin Starr describes the transformation of Los Angeles by the 1920s: "Nighttime Los Angeles had become a wonderland of light. From atop Mount Lowe one beheld Los Angeles, Pasadena, and fifty-six contiguous cities and suburbs spread out in a vast sea of illumination. In sheer extent...there was no other spectacle like it in the United States" (Starr 1990, 157) (Figure 13). Gradually, between 1910 and 1930, residential use of electricity for lighting and home appliances added to the twinkling of urban consumption patterns (Nye 1990, 238–86). In a more subtle fashion, electricity also

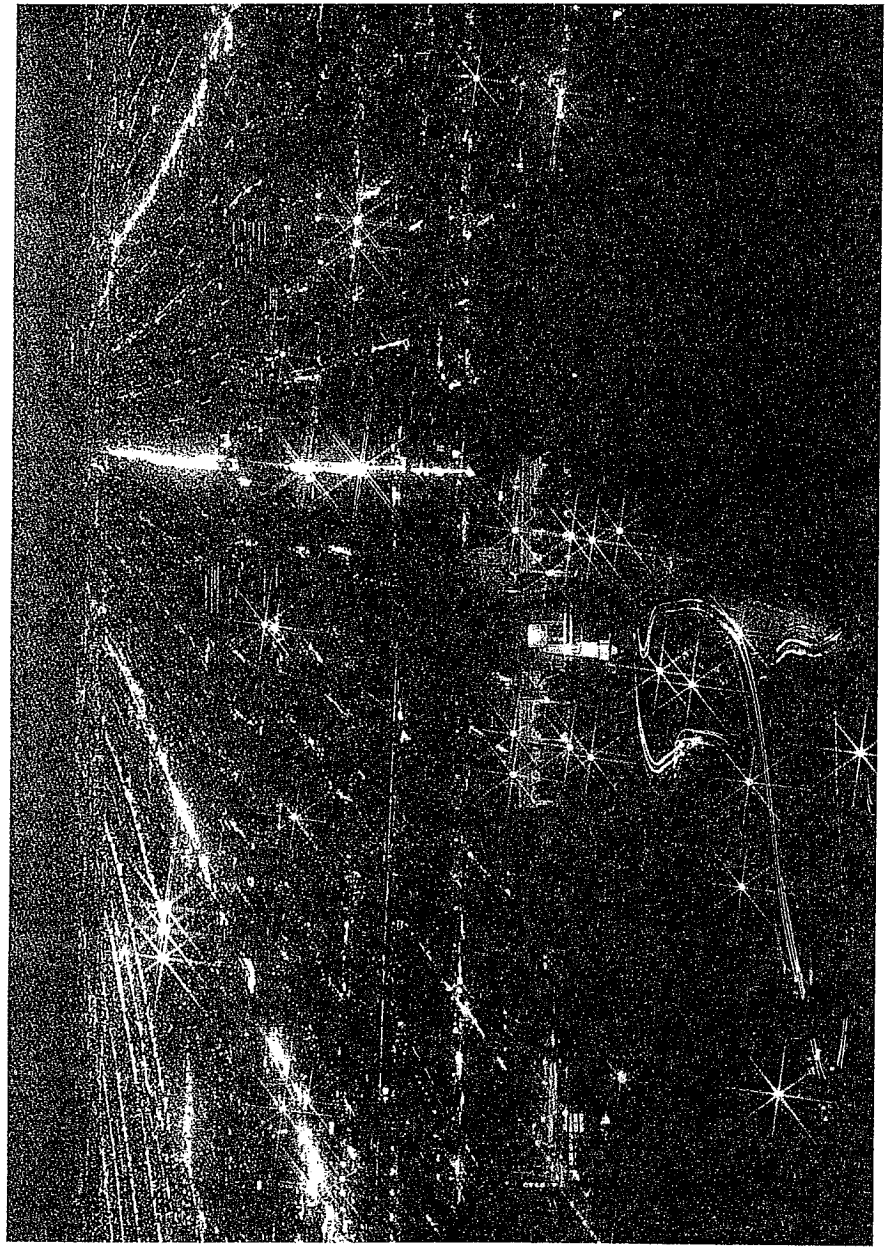

Figure 13.
Los Angeles at night is an electric landscape that can be seen from space. *Postcard from the collection of W. Wyckoff.*

made possible a fundamental reconfiguration of California factory layouts, a transformation that remains apparent today (Brigham 1998, 134–38; Nye 1990, 185–237; Williams 1997, 203). With widely available electrical power, factories could be designed to be more horizontally extensive and less dependent on centralized steam-generating facilities. Indeed, after 1910, new industrial plants in California widely adopted the approach, which often included the use of longitudinally extensive and more efficient assembly line manufacturing processes.

In the countryside, Californians rushed to electricity more quickly than any other rural Americans (Nye 1990, 23–25). By 1934, 60 percent of California farms were electrified, while the national total stood at only 11 percent (Williams 1997, 222–23). One enabling factor for many California farmers in the Central Valley was the close proximity of electricity in the form of transmission lines that connected the Sierra Nevada with the state's urban areas. Tapping into this grid allowed California farmers to vastly expand their use of electric irrigation pumping that allowed for the continued elaboration of the agricultural landscape (Smil 1994, 188–91; Williams 1997, 224–231). By the late 1920s, over 12 percent of the state's total electricity consumption came from pump irrigation operations and this technology remains essential today in providing water for many California farmers. In addition, electric motors have proven pivotal in modernizing many other farming activities, including the use of new milking machines, poultry brooders, and refrigeration facilities. Indeed, from the state's rural periphery to its brightly illuminated downtowns, electricity has enduringly reconfigured the cultural landscape of the Golden State.

Passage of the Wright Irrigation District Act, March 7, 1887

Artificial irrigation has been the mainstay of economic prosperity in California. However, until the passage of the Wright Act (Assembly Bill 12) on March 7, 1887, few farmers had the legal or practical means to obtain stream water for irrigation. The legislative passage of the Wright Act not only overcame this barrier, but also paved the way for the rapid expansion of irrigated agriculture in California.

During the first decades of statehood, the right to exploit stream water was influenced by English common law, Spanish practices, and gold rush innovation. Under the former, the doctrine of "riparian rights" prevailed in England and the eastern United States. This principle held that only those people living on a stream bank could lay claim to it. California officially adopted this common law in 1850, but gold seekers found it unsuitable for hydraulic mining. They adopted the custom known as "appropriation." Resembling Hispanic water law, the appropriation

While dictated that many people could divert stream water for beneficial uses with priority going to the first comer. In 1851, California also endorsed appropriation in the gold country and ultimately incorporated both doctrines into statewide law in 1872. The legislative willingness to accommodate these contrary doctrines caused considerable confusion and litigation especially concerning crop irrigation (Hundley 1992, 67–85). The jurisdictional uncertainties, anger over land monopolists, and the inability of small landholders to afford to construct and manage irrigation projects, in turn, resulted in the passage of the Wright Irrigation District Act in 1887.

The Wright Act authorized residents in an area to organize irrigation districts, purchase land and water rights, and distribute water. Importantly, the districts could condemn all individual water rights, including riparian, and purchase them in the name of the district. Once the obstacle of riparian priority was removed, dozens of public districts rapidly formed in California and large-scale irrigation commenced. A surge of landless immigrants and small landholders rushed to take advantage of these new opportunities, and by 1889 California led the nation in irrigated acreage (Kahrl 1978, 26–27; Hundley 1992, 99–100). In the 1890s many districts fell on hard times owing to drought, poor management, and insufficient resources for comprehensive interbasin projects (Worster 1985, 110). Nonetheless, the Wright Act had established the legal precedent for future rural and urban developments, and water districts were in the forefront of the massive expansion of irrigation that blossomed in the twentieth century (Kahrl 1978, 63; Pisani 1992, 104; Littleworth and Garner 1995, 17).

With the Wright Act and associated amendments as the legal and distributional framework, the federal and state governments provided the money, centralized planning, and advanced engineering necessary for ambitious interbasin water transfers (Stene 1994; Duvall and Duvall 1997, 202). California benefited greatly from the passage of the federal Reclamation Act of 1902, which provides federal money to finance water projects in the West. Water made available under the auspices of the Reclamation Act was distributed according to the water laws of the states (Robinson 1979, 332). The Wright Act had sanctioned the formation of water districts and they in turn provided the framework for effective and widespread distribution of federal irrigation water. In short order, the Bureau of Reclamation undertook massive water projects in regions such as the Salton Basin and the Great Central Valley. For example, the Bureau's Central Valley Project, built between 1937 and 1951, supplies water to local rural and urban water districts, which manage and distribute it. Subsequently, the California State Water Project further augmented the surface water available for irrigation. Similarly,

approximately sixty-five percent of the water transported by the California Aqueduct is destined for agricultural water districts in the San Joaquin Valley (Littleworth and Garner 1995, 25). The landscape consequences of these projects, and agricultural irrigation in general, cannot be overstated. The visual signatures are ubiquitous and revealed in the water facilities, irrigated lands, farm related industries, and in their environmental consequences.

The irrigation infrastructure in California is visible over major portions of the state and especially within agricultural regions such as the Imperial, Salinas, and Central Valleys. The Central Valley and State Water Projects together include forty-two major dams and reservoirs, 1,200 miles of aqueducts, twenty power plants, and dozens of pumping plants (California Department of Water Resources 1998) (Figure 14). As impressive as these projects are, they represent only a portion of the storage, power, and conveyance facilities that contribute to irrigation in California. A remarkable number of additional Bureau of Reclamation, Army Corps of Engineers, and private projects account for most of the 1,300 reservoirs and associated facilities in the state. Furthermore, some urban water systems are designed for the storage and distribution of irrigation water as well. The Hetch Hetchy project and the Colorado Aqueduct are notable examples of systems associated with irrigation. Many of these reservoirs are equipped with hydroelectric facilities that distribute power to urban and rural landscapes across California.

Artificial irrigation provides not only the backbone of agriculture in California, but also is important for recreation. Approximately, sixty percent of the recreation in California involves water bodies, and artificial reservoirs comprise a substantial portion of them (Kahrl 1978, 92–93; Selby 2000, 209). Shasta, San Antonio, Pine Flat, and Lake Havasu reservoirs, as well as the Salton Sea, are wholly or partially products of irrigated agriculture and serve as important recreation destinations. They have generated a host of business, service, and administrative landscapes at the water bodies, along access routes, and in gateway communities. Like their urban counterparts, the watersheds, reservoirs, and conveyance right-of-ways have constrained other forms of commercial and residential development. This is especially true around some reservoirs, such as Shasta and Trinity Lakes, which are encompassed completely or partially by national recreation areas or state and county parks (Benchmark Maps 1998, 10–33).

The spatial extent of irrigation in California is unsurpassed. By 1995, over nine million acres in California were artificially irrigated by surface and well water (California Department of Water Resources 1998, ES4–8). One-sixth of all the irrigated land in the United States is concentrated

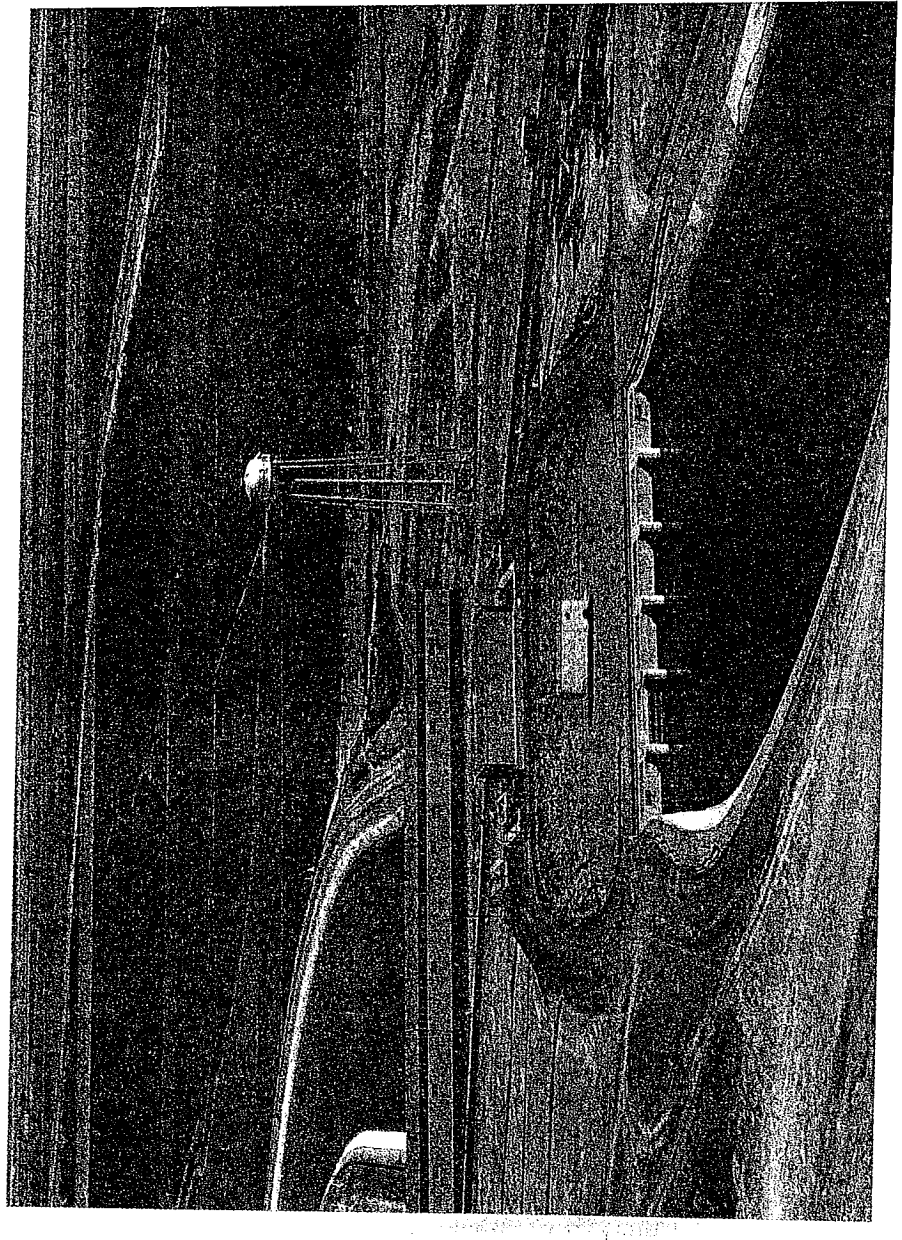

Figure 14.
The California Aqueduct and the Dos Amigos Pumping Plant in the San Joaquin Valley.
Photograph provided by California Department of Water Resources.

in California's Central Valley alone (Duvall and Duvall 1997, 201–202). In total, nearly one-tenth of the state's surface is under irrigation. Depending on the season and plant variety, environments that were once desert, grass, shrub, marsh, woodland, or meandering sloughs have been transformed into lush geometries of color and texture. These fields, orchards, and vineyards are further laced with settlements, utility lines, sprinkler systems, wells, pumps, canals, pipelines, equipment yards, service roads and, in some locations, the technology to combat frost.

Irrigation is responsible for the larger portion of the nearly $30 billion in annual revenues derived from agriculture in California, and its economic impact has transformed landscapes beyond the farm and ranch. In 1997, for example, nearly one-third of all jobs in the Central Valley came from farming or farm related industries (Brickson 1998, 12). When employment and profit reinvestment is considered, irrigation provides significant and varying economic underpinnings for urban and rural landscapes across the state. Ironically, irrigated agricultural landscapes are being supplanted by suburbs in many areas of California due largely to their own economic success (California Department of Water Resources 1998, ES1–2).

The irrigated agriculture promoted by the Wright Act has also spawned unintended consequences that are themselves expanding components of California's visual landscapes. The Salton Sea is a major example. Early endeavors to provide irrigation water to the dry Salton basin unwittingly resulted in its flooding by the Colorado River. Wastewater from the irrigated lands of the Coachella and Imperial Valleys continues to sustain the sea as a completely human-made water body. Soil damage is a growing problem in areas such as Sacramento–San Joaquin Delta and the Central Valley. Hundreds of thousands of acres have been rendered useless or less productive by saltwater intrusion, waterlogging, salinization, and erosion (Hundley 1992, 364–380). Moreover, various methods of agricultural wastewater disposal are increasingly important as landscape agents and features. Owing in part to wastewater, numerous stream, bay, and delta environments have lost their fisheries and the cultural manifestations they once supported. Some environments, like Kesterson Reservoir, the San Luis Drain, and thousands of acres of evaporation ponds in the San Joaquin Valley, were constructed to specifically address agricultural pollution (Department of Water Resources 1990). Although not as perceptible as reservoirs and canals, land subsidence due to ground water withdrawal is widespread and significant. This process has lowered ten percent of the land in the Central Valley (Lofgren and Klausing 1969). Irrigation, regrettably, is directly responsible for these changes and its visual impacts are growing.

important landscape agencies in California. The experiences of colonial peoples and gold miners assisted its development. In addition, technological innovations, new energy sources, and government assistance were factors in the growth and success of irrigated agriculture. However, ultimate success depended on the ability to transport stream water to non-riparian lands and then effectively distribute it to farms. The Wright Act of 1887 and its amendments made this possible.

San Gabriel Timberland Reserve, December 20, 1892

Forest conservation was a topic that gripped eastern intellectuals and scientists in the late nineteenth century. Various associations and, after 1881, federal agencies sought to protect a resource that was dwindling alarmingly. This concern led Congress to pass what is now called the Forest Reserve Act in 1891. It allowed the president to unilaterally withdraw public lands for what would become the national forests. Twenty-one months later Benjamin Harrison proclaimed California's first unit, the San Gabriel Timberland Reserve, now part of Angeles National Forest. Over the next fifteen years, citing needs for timber and watershed conservation, presidents proclaimed units in California that now form eighteen national forests and one national grassland. They total 20,652,922 acres or twenty percent of California's area (Figure 10). The United States Forest Service, an agency of the Department of Agriculture administers these lands (Ayres 1958; Clary 1986, 3–28; Steen 1976; US Forest Service 2000).

Establishment of the national forests initiated two profound processes that have affected the California landscape. One was the withdrawal of lands from the public domain, halting private land alienation. The existence of permanent federal conservation lands has halted sprawl from Los Angeles to Lake Tahoe. At the former, much of the region's recreation depends on the open space provided by national forests ringing the bloated metropolis. In El Dorado National Forest, the old resort of Tallac at South Lake Tahoe exemplifies one side effect of such designation–historic preservation. A private, water-oriented subdivision abuts the forest boundary a little over a mile from the late nineteenth century complex (US Forest Service 1990; Fiske 2000).

In 1931, the Forest Service established eight "primitive areas" in California. This form of management zoning excluded roads, tourism development, and most other forest activities in favor of ecological preservation. Designation of primitive areas in California and within the country's other national forests led ultimately to the Wilderness Act of 1964 (78 Stat. 890). Under that law, Congress has created 4.5 million

acres of wilderness in California, the majority on Forest Service lands. (US Forest Service 1960; US Forest Service 1998).

The second process to affect the California landscape was Forest Service management, a body of laws and policies underlain by a righteous mission of utilitarian conservation. During the nineteenth century, California's forestlands suffered decades of overgrazing, random, shepherd-set fires, and scattered deforestation. Erosion and soil depletion followed, especially in the southern part of the state. Areas such as the Tahoe Basin, adjacent to Nevada's silver mines, were particularly hard hit (Strong 1984, 11–33). The Forest Service responded by severely limiting grazing and regulating logging during the twentieth century (Figure 15). In 1902 the agency began to reforest its lands. In the first few decades, foresters tried to expand the forests into brushlands and experimented with exotic species. While most of these efforts failed, the agency also favored commercially valuable western species, influencing the overall forest composition. Agency foresters continue to breed and plant superior, insect-resistant stock while maintaining a seed bank to replace species eliminated by epidemics. Over the decades the agency has allowed clear-cutting followed by even-age reforestation in some places and selected species cutting in others, notably the sequoia groves of the southern Sierra Nevada (Clary 1986; Fiske 2000; Kitzmiller 1990).

Added to these actions is the agency's history of dynamic fire suppression. Taking its cue from the railroads, the Forest Service developed an effective fire prevention system that it shared with the National Park Service and other agencies. That prevention system, coupled with aggressive suppression, went unchallenged until the 1960s. The fire history of California's mountains and the degree to which suppression affected it are subjects of much debate among scholars. Yet the effects, while not quantifiable, are well understood and widespread: arboreal recovery, succession of meadows to forest, community composition change as serotinous species give way to others, and adjustment of the fauna which have their own landscape impacts (Ayres 1958; Cermak 1998; Sampson 1999). The net results of all these actions are an increase in the state's forest cover since 1900 and a humanization of those forests.

The Forest Service manipulated other resources in its units. Conners (1992) has shown that the Forest Service became the chief arbiter of reclamation development in the mountain watersheds prior to the Federal Power Act of 1920. By approving some projects and denying others it shaped the riparian history of both highlands and lowlands. Recreation development in the forests has also been extensive. Los Padres National Forest alone has more than 200 permits for second homes on its lands. Other California national forests match or exceed it.