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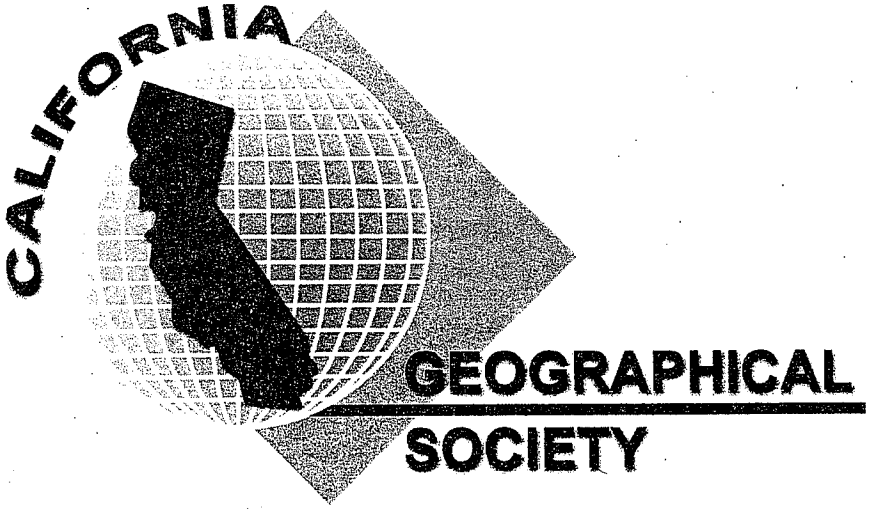

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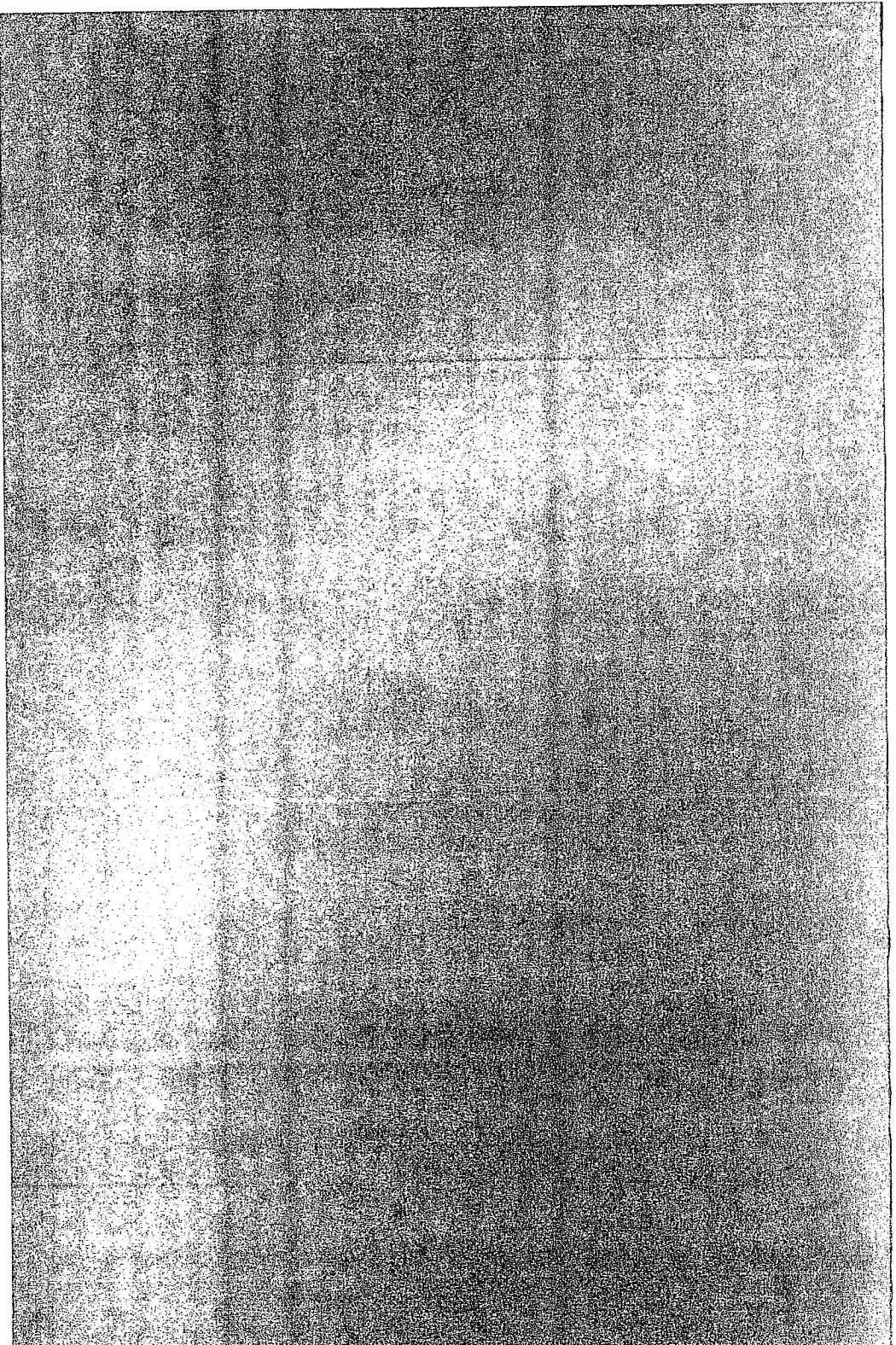

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Fifteen Events That Have Shaped California's Human Landscape

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The year 2000 has many meanings for the people of California. Aside from the celebration and cerebration occasioned by the end of the century and the millennium, it is the sesquicentennial of the state. It is fitting then that among the numerous chronological analyses and rosters of greatness accompanying the passage of the twentieth century, we reflect on California and what kind of place it has become. Although many scholars, pundits, and personalities have included California in their local and regional reviews, there has been little attention to the historical geography of the state's human legacy. With this article we hope to begin the remediation of that deficiency.

We have chosen to present the fifteen events that have most affected the human landscape of California. The geographic concept "landscape" means the visual "look of the land" as used by the German geographer Otto Schluter and defined for American geographers by Carl Sauer (1925) in his seminal article "The Morphology of the Landscape." Indeed, Sauer began a tradition of cultural landscape study that shaped much of twentieth century cultural geography in the United States. Lowenthal and Prince (1964) provided the best expression of the approach used in this article with their definition of the landscape as a palimpsest in "The English Landscape." Humans have inhabited California for at least 150 centuries, possibly more. Each generation has altered the landscape. However, all but the first began from a base of earlier human modification. Some changes came close to sweeping away earlier patterns. Not one completely erased those patterns. The cumulative effect of their activities has altered and humanized the appearance and the substance of the state's diverse natural environments. These changes can be detected at any scale, from the pedestrian's viewscape to the California filmed from the space shuttle.

The human impact on the landscape is apparent in both what is present in a scene and what is absent. Cities, roads, farm fields, and channeled

streams are deliberate impositions. The legacy of human error and improvidence is also evident. Vegetation change stems from accidental introduction of exotics or indirectly from alteration of the fauna as well as from burning and clearing. Even the persistence of a vegetation community often reflects deliberate decision to preserve selected resources.

Geographers do not often use specific "events" to explain the landscape and the human agency acting upon it. However, it can be a useful heuristic device. In the centuries of continuous human activity in California, certain processes have had the greatest cumulative impact. We choose to identify the fifteen punctuations of the state's timeline that began the most influential processes. Where a process such as the use of automobiles began elsewhere, we have generally chosen its arrival in California as our event. These processes, in turn, spawned related but independent processes and exerted both direct and indirect impacts. Thus, the arrival of the automobile directly set off the processes of large-scale road building, oil drilling, expansion of tourism, and the remaking of urban places. Indirectly, pollution from cars has impacted natural scenes by harming vegetation from the coastline to the Sierra Nevada and beyond.

One of the difficulties in choosing fifteen events was deciding which stand apart from the ongoing intertwined processes of human occupation. One could argue that the arrival of humans was the main event and the rest followed as a matter of course. In each event we try to show a compelling break from the trend of human activity and elucidate its direct and derivative processes. Thus, the establishment of wilderness areas in the state does not stand apart. It results from the creation of national forests and the policies of land management that evolved to protect and use them. Alternatively, some forms of irrigation preceded the Spanish, but the Wright Irrigation District Act enabled projects on a scale so pervasive that it serves as separate event and process.

Why fifteen events? There is a precedent for the number. Historian Rockwell D. Hunt (1958), in four consecutive numbers of the *Southern California Quarterly*, published "The Fifteen Decisive Events of California History." He explained that he based the number on Sir Edward Creasy's *The Fifteen Decisive Battles of the World from Marathon to Waterloo* (1851). We concur with Hunt's statement that:

> Certainly there is no magic in the number fifteen–it is simply a convenient number that has been suggested by Creasy; large enough to afford a respectable variety of phases in human events, sufficiently small to avoid the pitfalls of particularism (4).

We hope to satisfy two ends with this essay. First, we reiterate that this is not a definitive statement. Instead we hope this is the beginning of a scholarly debate. Most likely, everyone who reads this will disagree with at least one or two of our choices. We encourage all to challenge our analysis and, in so doing, further historical geographic inquiry about the Golden State. Second, this article may serve as a ready paradigm for teaching geography at the K through 12 grade levels. The type of diagnostic landscape analysis we employ is eminently useful for getting students to reflect on the reality of geographic themes in the scenes that they view. Each student can choose an area and evaluate how important these events or any others have been in shaping its landscape.

We believe the following fifteen events began processes that have had the greatest impact over the widest area on the visual appearance of California's landscape. The first two are the arrivals of the first people thousands of years ago and the Spanish nearly five centuries ago. The pervasive influence of the American cultural legacy can be divided into four categories. The imposition of settlement form includes the initiation of the rectangular land survey and the earliest suburbs. Economic development came with the discovery of gold, the diversion of water to cities, the establishment of irrigation districts, and World War II. Looming large throughout the landscape are technological innovations including the railroad, heralded by the arrival of the transcontinental line, electrification, the appearance of mass produced automobiles, and the invention of the Intel 8080 microprocessor leading to the personal computer revolution. Finally, the feverish expansion of development has been blunted or shaped by three signal events in conservation. These are the establishment of Yosemite, grandfather to all national and state parks in California, the creation of forest reserves, today's national forests, and the passage of the National Environmental Policy Act. We have chosen them based on their impacts throughout the continuum of scale. Some effects are most apparent to the individual on the ground. Others impact the tapestry that is the entire state, accounting for both the range and spatial distribution of human phenomena. We present them in chronological order beginning with the most fundamental event of them all.

Settlement by the First Peoples, 15,000 Years Ago

Landscapes in California have been dramatically altered and shaped by humans for at least fifteen millennia. Indeed, approximately 15,000 years ago people settled permanently in California and began humanizing processes that are revealed in the state's contemporary settings. The aboriginal legacy is observed most readily in the wild lands of California but is expressed as well among settled landscapes.

California was sporadically visited during the initial migrations that introduced Old World humans to the Western Hemisphere. This period coincided with the last glacial, or Late Wisconsin, stage of the Pleistocene epoch. By 15,000 years ago, descendants of these first migrants, accompanied by more recent arrivals from the Old World, came to stay and make California their permanent home. They traveled to the area of the future state by both land and sea and adapted to environments governed exclusively by natural processes (Erlandson et al. 1996).

At the same time, California was experiencing rapid climate-induced changes as the glacial period subsided and the transition to modern or Holocene conditions progressed. Despite these environmental fluctuations, the first permanent settlers skillfully and successfully adapted previous lifeways to a variety of habitats within California. Immigrants who arrived by sea initially subsisted on plants, small terrestrial animals, and marine life that thrived along California's coast (Jones 2000). Those who entered California by land were accustomed to big game hunting as a means of survival. They discovered a fertile setting for their traditional economic pursuits owing to the state's diverse assemblage of late Ice Age megafauna. Due to the hunters' skill as well as the animals' inexperience with human predators, approximately 75 percent of the larger (100 pounds or more at maturity) genera of game animals were liquidated within a few thousand years (Martin 1984, 258). As a consequence, subsequent human residents inherited a relatively impoverished zoogeographical landscape where such animals as mammoths, saber toothed cats, and ground sloths were no longer part of the biota. One can only conjecture what portion of the megafauna would have survived to the historic period had these hunters not come when they did. However, the composition of the contemporary fauna and the structure of associated habitats would be markedly different (Owen-Smith 1987).

Owing in part to the substantial reduction of the state's large game, Native Californians redirected their predation to the remaining fauna and intensified their utilization of the state's impressive array of plants. Although few large species were driven to extinction after 6000 years ago, favored marine and terrestrial animals were locally decreased by hunting to the point that they became insignificant in aboriginal diets and resource areas (Broughton 1994, 372; Douros 1993, 557–58). These animals include various pinnipeds, otters, bears, beavers, and ungulates such as elk, antelope, and deer.

Ancient animal depletions and extinctions continue to influence contemporary landscape expressions in myriad ways. The structure and species content of ecosystems are determined from the bottom up by flora that is largely an expression of climate and also from the top down through the actions of animals. A change in any one of these factors results in alterations that cascade through much of, if not the entire, ecosystem (Huntly 1995). The relationship between otters and kelp beds provides an example. California's kelp bed habitats are dependent on solar energy as well as upon otters that prey on sea urchins that, in turn, destroy kelp. The removal or reduction of sea otters by humans will unleash alterations that ripple through the kelp habitat (Estes et al. 1978). Every terrestrial animal, to a greater or lesser extent, also exhibits analogous engineering roles in their respective ecosystems. The elimination of at least 75 percent of the megafauna and the subsequent reductions in the spatial and numerical presence of surviving wildlife by California's first peoples yielded environmental changes that are interwoven into the character of the state's contemporary aquatic and terrestrial landscapes (Lawton and Jones 1995, 141).

Pre-Columbian people also contributed to the contemporary presence of certain animals by transporting species to alien habitats. The introduction of foxes to the Channel Islands by Native Californians is one example (Schoenherr 1992, 708–09). The intentional modification of vegetation communities by fire and other means further altered animal demographics and distributions by increasing or decreasing the carrying capacity of some habitats. For example, the expansion of grassy prairies in the redwood forests of northwestern California increased the carrying capacity for preferred animals like deer (Dasmann 1994, 19; Lewis and Ferguson 1999, 167–68). These modifications then rebounded onto the vegetation communities due to the resulting increases or decreases of these animals' engineering influence.

Due primarily to population pressure and the depletion of large game, Native Californians compensated by using a host of techniques to increase their vegetative resources. These included the applications of fire, pruning, coppicing, weeding, transplanting, and broadcasting (Blackburn and Anderson 1993). Where the first Californians used these practices on a sustained basis, they markedly restructured landscapes and altered their species content.

Sustained burning reduced understory in both coastal and inland woodlands. In frequently burned oak groves a spacing of single oaks developed that later colonial people described as oak park woodlands (Anderson and Moratto 1996, 200; Rossi 1979, 84–90). Furthermore, the distribution of chaparral associations on coastal and interior hill slopes still reflects the ancient effects of anthropomorphic fire (Schoenherr 1992, 328–362). At higher elevations in the Sierra Nevada and Cascade ranges, intentional aboriginal burning complemented lightning fires in allowing

the expansion of fire- dependent forest trees such as ponderosa pine and sequoias. Indeed, everywhere in the state's lowlands where human-set fires were common, grasslands expanded at the expense of brush and woods (Bakker 1971, 168–69, 186).

In some locations, native peoples augmented fire with other horticultural techniques to improve the quality and abundance of floral resources. Plant species were both intentionally and unintentionally disseminated by broadcasting and transplanting as well as through processing and storage. For example, many of the oak trees observed around bedrock mortar sites result from acorns the Native Californians transported there (Anderson et al.1997, 37–38; Bonnicksen et al. 2000, 453). These practices had consequences that extended beyond the organic world. For instance, intense management by native peoples increased and made more reliable local water yields (Biswell 1989, 156; Shipek 1993). Colonial processes curtailed and quickly terminated native people's manipulation of vegetation. Nevertheless, over thousands of years Native Californians shaped the organic stage on which these subsequent, often extreme, developments occurred. Their ancestral practices, thus, remain integrated in various degrees within the fabric of many contemporary wild lands (Anderson and Moratto 1996, 194). Modern land managers in government reserves like Sequoia National Park have adopted one of these ancient practices, prescribed burning (Biswell 1989).

The heritage of Native Californians is also manifest in a variety of settled landscapes. Historically, the altered aboriginal territories first observed by European and North American explorers helped formulate impressions of the settlement and economic opportunities in the region. These initial interpretations had bearing on the eventual geography and economy of coastal settlement by the Spanish. The siting of missions and the associated infrastructure of roads, ports, presidios, and pueblos are cases in point (Butzer 1990, 50; Hornbeck 1983, 40–45). Albeit not as pervasive, a variety of prehistoric cultural settings endure in many locations and influence modern landscapes. For example, portions of many roads and highways follow ancient aboriginal pathways. (Davis 1961).

Remnants of native settlements, resource processing areas, art work, and battle sites accentuate the rural environs of nearly every county, and at times provide destinations for tourists. These include Captain Jack's (Kientpoos) stronghold in Lava Beds National Monument in Modoc County and Indian Grinding Rock State Park in Amador County. Furthermore, nearly every one of the state's missions, presidios, and military forts boasts Native Californian interpretive components (Eargle 1993, 153–79). Roadside businesses, signs, and interpretive centers are just a few of the landscape features generated to entice visitors to these locations.

The contemporary descendants of California's first people also have a measurable and growing impact on the state's landscape. More than a quarter of a million Native Americans populate the state in the year 2000 and their numbers continue to grow. Many of these people live on over one-half million acres of tribal lands that are distributed in more than 100 locations (Peters et al. 1999, 180–83). Beginning in the 1980s, gaming casinos began to proliferate on tribal lands and number more than forty at present. They lure thousands of visitors and generate unparalleled wealth for various Native California groups. A portion of the earned revenue has been invested in infrastructure additions and improvements on tribal lands. In addition, native peoples hold an impressive number of festivals, dances, powwows, and other events on and off tribal lands that are open to the public (Eargle 1993, 180–83). All of these attractions have spawned an increasing presence of lodging, advertising, and other business opportunities in their vicinities. These most modern additions combine with the millennia of alterations that have permanently affected California's human landscape to belie the familiar axiom that colonial peoples erased the Native Californian legacy from the earth.

Cabrillo's Landfall at San Diego, September 28, 1542

Not long after the legions of Cortez laid siege to the Valley of Mexico in 1519, Old World peoples and organisms began to probe California's frontiers. The earliest substantial visitation was the voyage of Juan Rodriguez Cabrillo in 1542–1543. Cabrillo's exploration along California's coast initiated landscape-altering processes that equaled if not surpassed those of the first people at the end of the Pleistocene epoch.

Cabrillo and his crews did not establish permanent settlements. However, his and other foreign explorations unwittingly introduced Old World germs and weeds to California during the period prior to the founding of the first mission in 1769 (Erlandson and Bartoy 1995; 1996; Preston 1996; 2001). These organisms persisted, became naturalized, and radically changed the nature of land and life over much of the state. Afterwards, colonial settlers augmented these unintentional processes with conscious introductions of alien attitudes, settlement frameworks, and a wide variety of domesticated plants and animals.

Native Californians and their environmental relationships were especially vulnerable to the exotic contagion that accompanied pre-mission

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Native Californians and their environmental relationships were especially vulnerable to the exotic contagion that accompanied pre-mission

explorations and colonial settlement (Preston 1996, 20–22). Diseases such as smallpox, measles, malaria, and virulent forms of syphilis progressively reduced native populations and destroyed traditional land use practices. As a consequence of reduced human predation, maritime and terrestrial game exploded in numbers and expanded spatially within native resource areas. Furthermore, native horticultural and associated practices such as burning, transplanting, and plant processing were disrupted and eventually terminated. These alterations resulted in more brushy understories in forests, changes in the distributions of some fire dependent plants, and extensive soil erosion caused by greater numbers of ungulates (McCarthy 1993, 223; McCullough 1997, 69; Preston 1997, 269–70, 277–81). In every environment where Native Californians were diminished or eliminated as top predator and keystone species, organic, hydrologic, and geologic aspects of the supporting ecosystem were altered (Garrott et al. 1993,946).

The periodic forays to the state by foreigners prior to missionization also conveyed Old World weeds like wild oats and other Mediterranean annuals that spread rapidly and extensively at the expense of native species (Mensing and Byrne 1999). The transformation of California's floral landscapes continued unabated during the colonial period. Indeed, Cabrillo and his associates initiated a process of botanical replacement that is still in progress today. As a result, approximately eighty to ninety percent of California's contemporary grass and shrub lands are now covered with exotic plants, and about 17 percent of all plant species growing wild in the state are of non-native origin (Blumler 1995, 310; Stein et al. 2000, 135). Elna Bakker (1971, 149) stated that, "this successful invasion is one of the most striking examples of its kind to be found anywhere." Alterations of California's other visual signatures abound, most notably the golden color of the grasses that lie beneath the state's oak groves during dry seasons. Californians deem it a quintessential characteristic of the state's natural heritage. However, prior to the arrival of Cabrillo, these same vistas displayed greener hues owing to the prominence of indigenous perennial grasses. Furthermore, the regeneration capacity and current distribution of many of the oaks in these settings are influenced by greater soil moisture losses and an increased presence of rodents afforded by exotic grasses (Griffin 1980; Danielsen 1990, 59). The widespread encroachment of Old World invasives such as tumble weeds also influences the diversity and distribution of a wide selection of plants and animals that occupy California's roadsides and wildland habitats. Relative differences in seasonal coverage and soil holding capacities between exotic grasses and indigenous species also have caused changes in runoff and associated soil erosion that have modified the appearance of some watersheds.

In addition to these unintentional invasives, Spanish exploration led to the introduction of a variety of domesticated plants and animals that comprise much of the state's contemporary agricultural landscape. Although Native Californians cultivated a small number of food plants, modern agriculture in the state began with the first permanent settlement at San Diego in 1769 (Bolton 1949, 165, 174). An impressive array of Old and New World crops such as grapes, maize, wheat, olives, and citrus were cultivated around the missions, pueblos, and presidios (Fig. 1) (Bryant 1967, 282, 316; Hornbeck 1983, 52–53). Later, Mexicans and Americans took note of these successful Spanish plantings and disseminated the crops and practices more widely throughout the state.

Colonial peoples also carried domesticated animals such as cattle, horses, sheep, and fowl to California. Livestock numbers quickly grew to enormous proportions in the mission realm and spread into the state's interior (Hornbeck 1983, 54–55). The impacts of these animals on plants, animals, soils, and watersheds were additive to the changes wrought by the irruptions of wildlife (Burcham 1957, 186–88; Schoenherr 1992, 718). Periodic droughts exacerbated the devegetation and soil erosion caused by overstocked ranges (McCullough 1969, 15). Today, the residuals of these effects are still observed in much of the gullying found in the coastal ranges and on the margins of the Central Valley (Latta 1936).

The presence of colonial livestock influenced subsequent economic pursuits and their contemporary landscape expressions. Owing to the Spanish and Mexican preference for domesticated animals as well as their late colonial ubiquity, many early Americans viewed much of the state as suitable only for livestock ranching. As a result, the San Joaquin Valley was initially utilized as a great, unregulated pasture (Preston 1981, 86–87). Many of the state's lowlands have now been subsumed by other economic pursuits; however, the legacy of traditional livestock ranching remains visible in contemporary landscapes. One fifth of the state's land is currently used for grazing livestock (Peters et al. 1998, 302) and their terraced trails show prominently on hillside lands. Barns, fences, and corrals are ubiquitous in many rural areas. California's long history of ranching has altered a variety of physical environments that range from valley riparian areas to mountain meadows in the Sierra Nevada. The livestock industry accounts for the alfalfa and some of the feed grains, such as yellow corn, that grace the state's agricultural regions. Furthermore, livestock raising has directly contributed to the presence of thousands of small dams, ponds, and wells that appear on rangelands. Indeed, agriculture is the foremost consumer of fresh water in the state and the livestock industry demands the largest share of it (California Department of Water Resources 1998, 4–26).

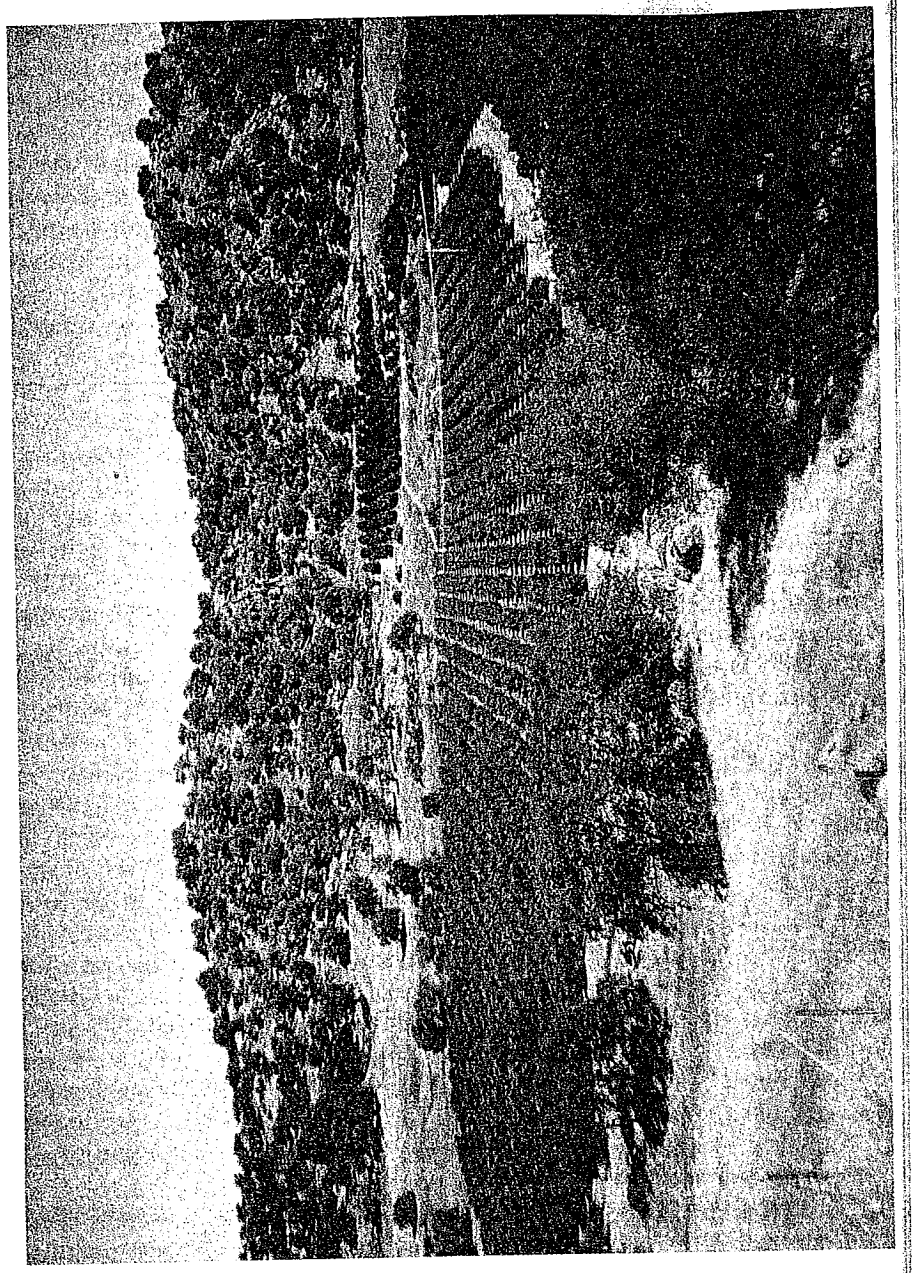

Figure 1.
Mediterranean grasses sweep down to an orange grove on Highway 180 near the Sierra Nevada foothills. The influence of the Spanish extends well beyond the areas they actively settled and used.
Photograph by W. Preston.

The origin of many of the attitudes, practices, and institutions that have contributed to California's evolving landscape can also be traced to the arrival of the Spanish. The Spanish as well as other foreign peoples arrived in the state with environmental attitudes that were considerably different from those of the native inhabitants (Preston 1997, 264). They viewed the state's physical resources initially as inexhaustible and entirely divorced from their own spiritual existence. As a consequence, colonial people possessed few inhibitions about changing the physical environment for the purposes of settlement, economics, and sport. Both sustained commercial forestry and irrigation began in the colonial period (Clar 1959, 12–44; Hornbeck 1983, 51–53). Furthermore, some of the rules that governed the exploitation of natural resources survived to influence post-colonial landscapes. As David Hornbeck (1990, 51, 60) explains, the "principles of mining, irrigation, water, and property rights of women stem from the Spanish regime...and the large corporate farmers of California share in a common water-rights system that is a thinly disguised copy of Spanish water law." Indeed, the state's ultimate adoption of "the doctrine of prior appropriation" as the legal framework for water use resembled the Spanish water law and allowed for the vast irrigated landscape currently observed (Hundley 1992, 72).

The initial Hispanic settlement infrastructure is also strongly reflected in California's contemporary pattern of roads, settlements, tourist destinations, property boundaries, and architecture. A number of colonial transportation pathways provide routes for important highways and roads. The conformance of Highway 101 with long portions of El Camino Real is a noteworthy example. The pueblos, missions, and presidios served as nuclei for most of California's largest urban areas. Today over seventy percent of the state's population live in one of the twenty-eight sites originally founded by Spain (Hornbeck 1990, 61). Many of California's twenty-one missions are important tourist destinations and they generate a host of landscape elements in the form of advertising and urban and roadside businesses. Furthermore, portions of the boundaries of many of the hundreds of ranchos that were granted during the colonial period have influenced the spatial patterns of countless urban and rural roads, fences, trees, power lines, and town boundaries in coastal regions such as the Santa Clara Valley (Broek 1932, 86, 94).

Most of the foregoing landscape expressions of California's colonial past are restricted to the western portion of the state. However, the adoption of colonial themes in built environments is more spatially pervasive. The aesthetics of the Hispanic architectural legacy (e.g., mission revival, arroyo culture, and ranch-style houses) are significant and increasingly common attributes of domestic and commercial landscapes (Pitt 1970, 291–96; Starr 1973, 390–414; Rice et al. 1996, 165). Housing tracts replete

with red tile roofs and Hispanic décor for fast food outlets and banks are typical examples of the heritage, appeal, and timelessness of the state's colonial legacy. (Figure 2) Also in many rural and urban areas are signature elements of a cultural scene created by today's Hispanic residents. Although most settled California after it became American, they represent continuity in Spanish heritage that lies heavily on the visible landscape.

The Discovery of Gold at Sutter's Mill, January 24, 1848

The story of the California Gold Rush with its compelling and romantic character is one of the most exhaustively researched topics in the West. Its inauspicious start, its ephemeral and unbalanced economic focus, and the mania that drew 250,000 people to the state in less than three years have become part folklore, part cultural genealogy (Gressley 1999; Holliday 1999; Paul 1947; Rohrbough 1997). Nobody denies its profound historical consequences not only for the region, but also for the nation and the world. Yet, two years ago, on the occasion of its sesquicentennial, several historians disputed its lasting effects on the modern state. Richard White (1998) posited that its immediate effects were superseded by later economic, demographic, and political processes. Others added that the transport, agriculture, and industry it brought would have come anyway to such a resource rich state (Bethel 1998). However, the discovery of gold ignited processes of economic development, settlement, environmental modification, and political adaptation that have spatial and visual resonance in California's landscape of today.

The most recognizable landscape legacies of the mining era are the mines, towns, water systems, and transport links that litter the foothill and desert districts of the state. Mining directly established the settlement framework in those otherwise undesirable nineteenth century locations. In Amador, El Dorado, Nevada, and Placer counties, the major towns, including all four county seats, and the roads that link them, began as parts of the gold rush infrastructure (Dilsaver 1982, 400–403). The historic character of towns like Auburn, Nevada City, Sutter Creek, and Sonora has made the Sierra foothills the fastest growing part of the state (Figure 3). Even abandoned towns, like Bodie and Columbia, entertain thousands of tourists and sustain a nostalgic idyll that draws the new rush of mobile workers and retirees. Mining towns are among the most recognized of historic landscapes in the country. They display a convoluted morphology and historical authenticity that stem from their adaptation to geomorphology and their unsuitability to functions other than tourism and telecommerce.

The abandoned infrastructure of mining is also present in these zones.

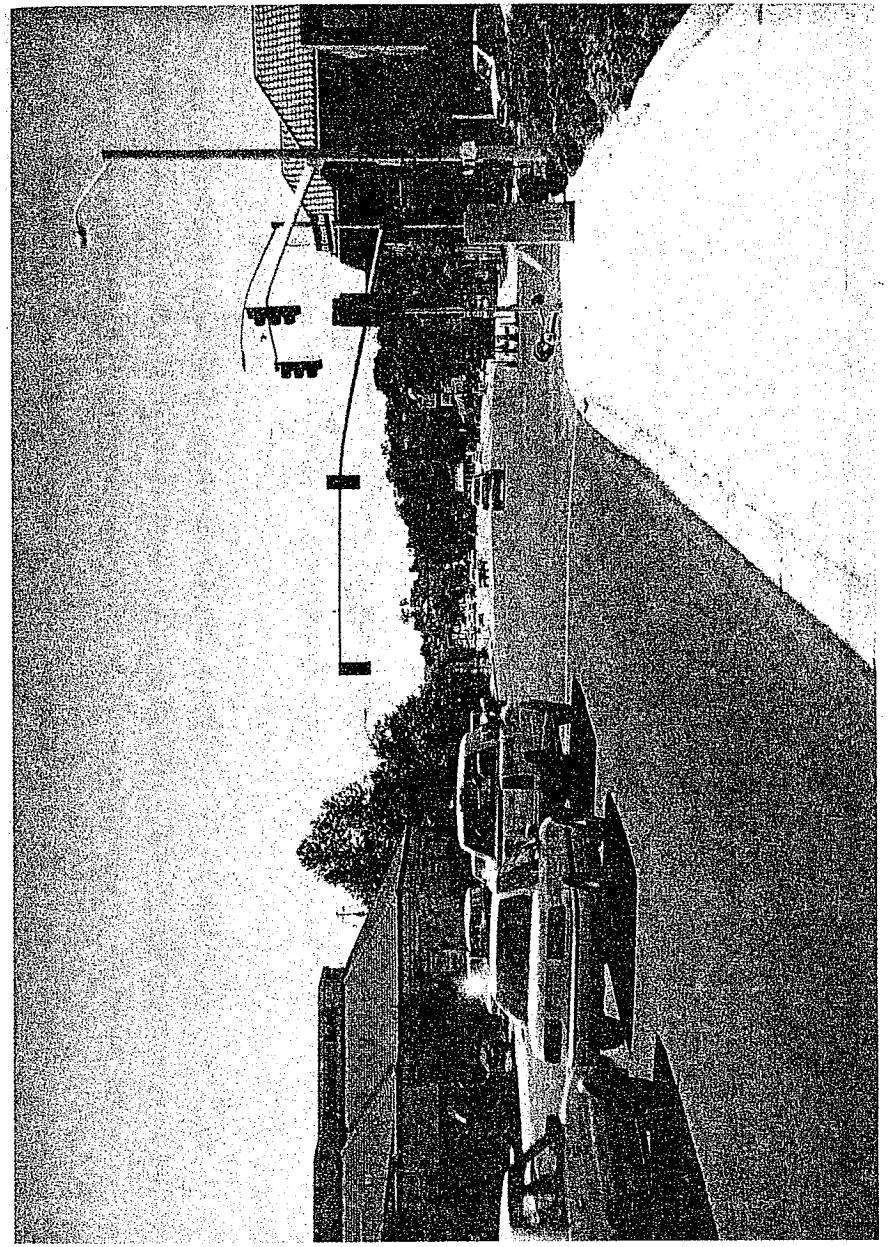

Figure 2.
The use of El Camino Real as a modern highway and Spanish style roofing in late twentieth century architecture are two persistent landscape legacies of Spain shown here in Atascadero.
Photograph by W. Preston.

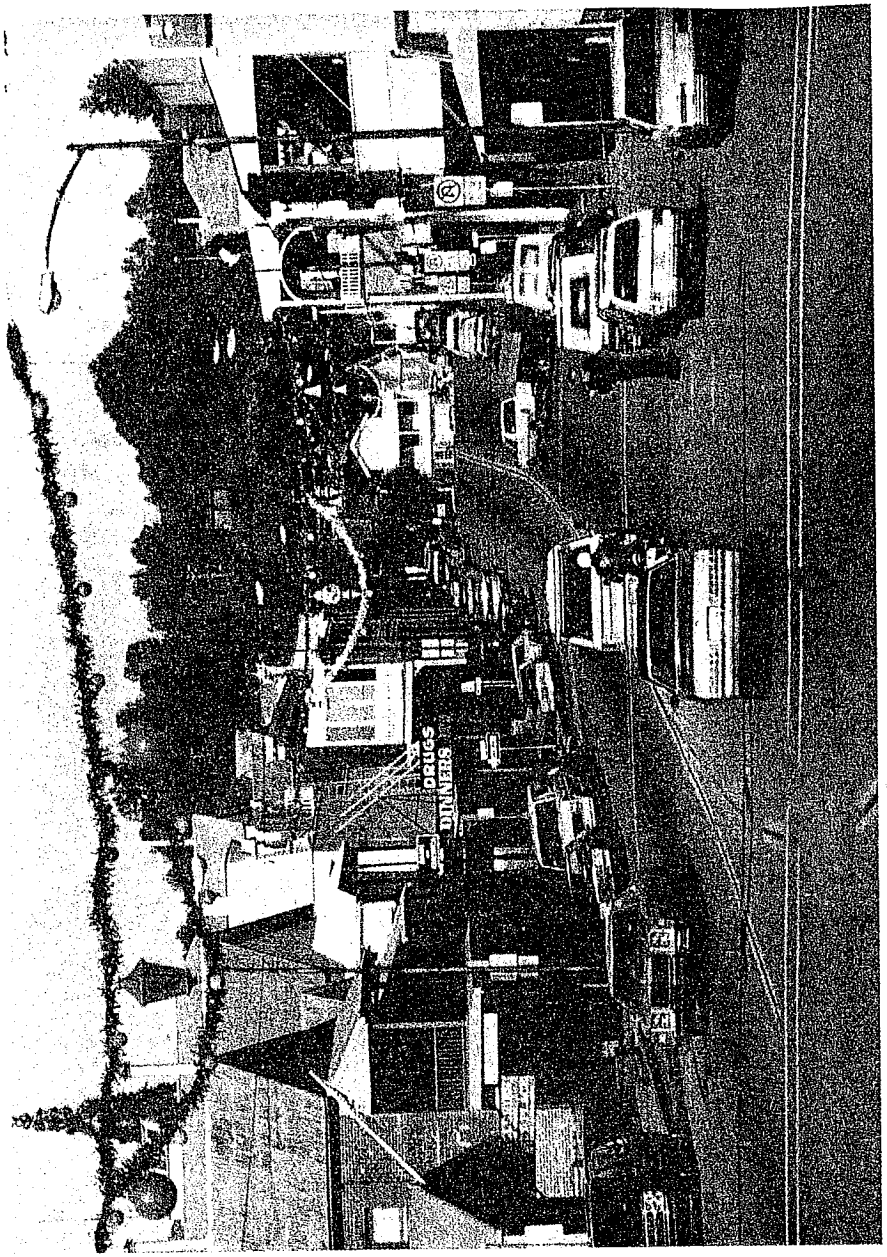

Figure 3.
The historic landscape of the Mother Lode is well represented by the town of Sutter Creek.

Photograph by L. Dilsaver.

The ruins of conveyors, mills, sluices, and equipment, and telltale piles of debris spotlight thousands of former mines. Due to their structural instability and the frequent presence of dangerous chemicals, state and federal agencies seek to identify and rehabilitate these sites. The Bureau of Land Management (1996) estimates that its lands alone (13.8 % of the state) contain 11,500 "Abandoned Mine Land" sites. Miners dug or constructed more than 7000 miles of ditches and flumes, among the earliest in the state. In many cases these also lay in ruins. However, these early water engineers also identified sources and water transport routes in the mountains that have been adapted for modern use by towns and agriculture (Rohe 1983). Their accession to high mountain water sources and elaborate distribution systems helped pave the way for California's adoption of appropriation and massive agricultural irrigation a few decades later.

Mining also helped plot the settlement pattern and urban character of California. Gold mining established the relative importance of Sacramento, San Francisco, and Stockton. Sacramento became the state capital based on its role as a mining supply center. San Francisco dominated banking and mining finance. The presence of mining wealth drew entrepreneurs who brought the state's earliest industry to the Bay Area and shaped its characteristics of light to medium assembly and consumer products (St.Clair 1998). The crowded and vertical financial district of today's San Francisco lies atop sunken gold rush ships. Limerick (1998) suggests that California's urban focused population also stems from the entrepreneurship and manufacturing derived from the mining industry. Furthermore, the distinctive Asian landscapes within California's largest cities ultimately owe their origins to Chinese gold-seekers.

The environmental effects of mining have been the topic of intense study and comment since the time of the gold rush. Grove Karl Gilbert (1917) calculated that the industry, especially through hydraulic mining, had deposited more that 1.6 billion cubic yards of sediment dwarfing the amount generated by natural processes and other human causes such as agriculture, grazing, and deforestation. The channel bottoms of some mountain streams rose several inches per year. In some cases river channels moved. Vast outwash deposits lay over the Sierra Nevada piedmont. Towns and agricultural fields flooded. The bed of San Pablo Bay rose more than three feet and 9000 acres of tidal mudflat were created around its edges. Mine sites like Malakoff Diggings at North Bloomfield became moonscapes as hydraulicking carved away these vast sediment loads (James 1994; Rohe 1983; USGS 2000).

Modern research has shown that erosion and revegetation have ameliorated much but not all of this amazing landscape disruption. Rohe

(1983) suggests that six feet of debris along the Yuba River is probably permanent. James (1994) found terraces formed by mining debris where rivers recut their channels into the raised beds. He concurs that they are "permanent over centennial time scales." All modern researchers agree that many millions of cubic yards of sediment still line Central Valley rivers (USGS 2000). Dredging overturned much of that sediment and left it in parallel rows of man-made eskers. Dredge spoils cover dozens of square miles along Sacramento River tributaries. At hydraulic mine sites, vegetation has reclaimed some cuts and tailings while others remain largely barren.

Mining introduced many other environmental impacts, some of which shaped the landscape in unexpected ways. Dasmann (1999) found that the mining era wiped out much of the large mammal population, especially bears. The latter are noteworthy because they function as "ecosystem engineers" in their natural habitats moving soil, uprooting trees and logs, dispersing seeds, and preying on other species (Lawton and Jones 1995). Mining, like no other function, impacted the fauna of mountainous areas where many minerals concentrated. At Grass Valley the collapse of shafts and stopes in the Empire Mine caused surface subsidence noticeable to anyone driving its streets. Most of the deforestation that raised the foothills tree line by up to 2000 feet and decimated the Tahoe area has been reversed. Yet the forest composition has been altered. In semiarid areas chaparral and digger pine often replaced ponderosa pine (Rohe 1983).

The gold rush also shaped the politics and culture of the state in ways that show in the landscape. The rush drastically accelerated Indian displacement or elimination. The widely scattered distribution and small size of reservations in California are byproducts of the geographically expansive search for wealth (White 1998). The international character of the rush brought large numbers of Chinese to California, resulting in enclaves of mixed Chinese and American appearance in most major cities.

The disorganized society of the early mining camps led to social attitudes and laws that have landscape expression. Batabayal (1998) suggests that they spawned an "economic liberalism" that decries government influence in use of public lands. Later Congress institutionalized this in the Mining Law of 1872 (30 USC 21–54 as amended). Among the effects of this sweeping law are more than 27,500 extant mining claims on federal lands in California (BLM 1996). The California Division of Mines and Geology reported 917 active mining operations in the state during 1995 (Youngs 1996). Individuals hold most of the remaining claims. As early as 1944, the Forest Service reported that 21 percent of the claims on its

lands were used for residential or commercial purposes (Friedhoff 1944). The agency now estimates that more than half the mining claims in the national forests are used for these purposes (Stone 2000). Thus, much of the infrastructure on California's federal lands owes its existence and distribution to a system of egalitarian and economically liberal laws devised hurriedly amid the placer mines of the state.

One final impact of the gold rush's legal legacy can affect the landscape in ways as startling as the hydraulic operations of twelve decades ago. Major corporations use the gratuitous Mining Law of 1872 to open-pit mine for gold. Some companies confidently plan to pulverize entire hills and retrieve the gold by a chemical process known as heap leaching. A landscape left behind by this operation will have its physiography, soil profile, and biota dramatically altered. Furthermore, as scientists ponder the significance of the world's most acidic water at Iron Mountain near Redding, both the landscape and the health consequences of mining's chemical residue remain unknown.

Initiation of the U. S. Public Land Survey, July 17, 1851

When California joined the United States in 1850 it became part of the nation's public domain and subject to the federal laws governing cadastral surveys. Congress enacted the law of the land, now known as the United States Public Land Survey or Township and Range System, on May 20th 1785 (Thrower 1966, 4). Sixty-six years later, on July 17th 1851, a contract surveyor named Leander Ransom inaugurated the survey in California by establishing an initial point on Mount Diablo (White 1982, 115). This solitary act initiated a process that has shaped landscapes throughout the state.

The Public Land Survey is noteworthy for its geometric organization and grounding in coordinates of latitude and longitude. Two sets of lines govern the grid. A north-south line, or principal meridian, intercepts an east-west parallel, or base line, at the initial point. Running parallel to both the base line and principal meridian are lines that form a latticework of rectangles that are called townships. Each township incorporates thirty-six square miles and is, in turn, subdivided into square mile sections. Furthermore, each section is progressively quartered into smaller and smaller geometric units (Campbell 1993, 171). Three initial points, including the original monument at Mount Diablo, were utilized to map approximately eighty-two million acres, or about four-fifths of the state. The only portions of California not mapped in this fashion were the colonial ranchos, the Channel Islands, and certain mineral lands (Uzes 1977, 147–148, 157; White 1982,117). The main intent of the survey was to exactly describe and identify land so that it could

be readily transferred by the United States, by the State of California, and by private individuals.

The Congress of the United States enacted a number of land alienation policies – the body of laws that govern land transfers – that assisted in the distribution of the public domain to state and private concerns. Many of these measures, such as the Homestead Act of 1862, allocated parcels of land concomitant with the quarter sections of the Township and Range System. Furthermore, the Land Ordinance of 1785 also contained provisions for the transfer of larger units such as the full sections granted in considerable numbers to the Southern Pacific Railroad. However, in an effort to inhibit the monopolizing of land in large contiguous units, only alternate sections were initially available for ownership by any individual concern (Johnson 1976, 143). These alienation policies and their cadastral context are visibly distinguishable on the landscape today.

In the San Joaquin Valley, for example, the moister eastern regions were settled relatively early during the 1850s and 1860s as the public domain was transferred to homesteaders through a variety of alienation acts (Eigenheer 1976, 275–284). Although these initial land ownerships were relatively small, the cadastral framework assured that farmsteads were spatially scattered and isolated from those of neighboring landholders (Jordan-Bychkov 1999, 79). On the other hand, where alternate railroad sections were present in the Central Valley, these lands were initially unavailable or avoided by early immigrants. Later, in the 1870s and 1880s when the railroad owners began selling off the sections that had been previously granted to them, landholders from adjoining sections or newcomers to the region began purchasing the available land in larger units. This explains why in some rural areas of California east of the coast range there are fewer farmsteads and associated settlement forms visible in sections once owned by the railroad (Preston 1981, 109).

Visual contrasts between alternate sections of townships are apparent in a number of other locations in California. A case in point is the pattern of planned housing developments in the Mojave Desert. Contrasting landscapes between alternate sections are distinctly revealed in the vicinity of California City where subdivided sections containing roads and houses are interspersed among sections of desert. Similarly, oil drilling and pumping in western Fresno and Kings counties began on alternate sections during the first decades of the twentieth century. Since then, oil development has spread in some areas to adjoining sections, but the checkerboard contrasts between the landscapes of oil and ranch or farm land still exist (Jennings 1953).

The Public Land Survey has contributed both directly and indirectly to the contrasting landscapes between certain regions of the Great Central Valley. In contrast to the east side, a much greater portion of the land on the west side of the valley was monopolized during the 1860s and 1870s. Owing to the inaccurate environmental assessments of the original surveyors, the availability of land, and the fraudulent use of alienation policies such as the Swamp and Overflowed Lands Acts and Military Scrip, the public domain on the west side was acquired by relative few claimants (Eigenheer 1976, 312–320). Land speculation was often the motive for these endeavors, and resulted in the removal of huge portions of the public domain. Most notorious among the monopolists was Henry Miller whose acquisitions included a one hundred mile stretch of land along the San Joaquin River (Robinson 1979, 192–193). The contemporary legacy of his and other land monopolies during the nineteenth century is readily visible in the extensive corporate landscapes that contain larger fields and fewer homesteads than the rural landscapes on the eastern side of the valley (Preston 1981. 111–112). An indirect consequence of this division is that settlements on the west side of the valley such as Mendota and Corcoran tend to be more impoverished than those in the east as fewer landowners contribute less to the local economy. The corporate settings on the west side are largely responsible for these economic and settlement disparities and the visible landscapes of poverty bear testimony to the linkage between the Public Land Survey and community health (Goldschmidt 1978).

Perhaps the most striking contemporary legacy of the Public Land Survey is the visible geometry of rural California (Figure 4). In the flatlands it imparted rectangularity to the landscape that is visually inescapable. Public jurisdictional boundaries (e.g., parks, forests, military bases, national monuments, wildlife reserves), property lines, homesteads, fences, roads, canals, field and orchard patterns, and even a few water bodies clearly demarcate the cardinal orientation and checkerboard fabric of the cadastral system. The settlement infrastructure conforms particularly well to sectional boundaries, its rectangularity intensified through subsequent farm fragmentation and consolidation. In more densely populated areas, section lines serve as the framework for continuing subdivision.

County roads in the Central Valley, for example, usually conform to sectional and township boundaries. Many straight north-south roads make an abrupt right angle jog where they encounter the survey correction lines that occur every twenty-four miles north and south of a base line (Greenhood 1971, 25). Even interregional roads such as Highway 99 and Interstate 5 in the northern San Joaquin Valley are congruent over extensive stretches with the adjoining sectional or township

boundaries (Johnson 1976, 143; Johnson 1990, 137–141).

The impact of the Public Land Survey is equally impressive among urban landscapes where variations on the rectangular grid pattern sometimes occur. A number of settlements established by the railroad exhibit a rectangular street framework oriented to the tracks rather than to the cardinal directions inherent in the survey. However, once successful railroad towns expanded into the countryside, developers commonly broke from the original cadastral orientation established by the railroad and built in accordance with the Public Land Survey. The street patterns of Modesto and Fresno, like those in most railroad towns, display this phenomenon.

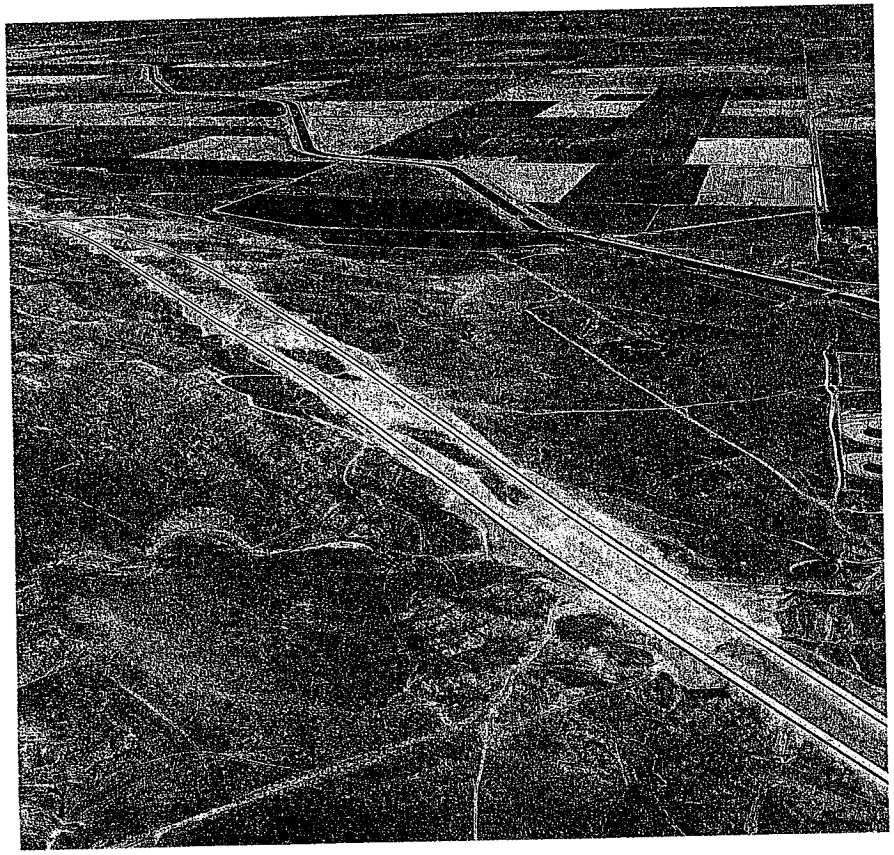

Figure 4.
The familiar checkerboard pattern of the Township & Range land division system is especially pronounced in flat areas such as the San Joaquin Valley near Kettleman City.
Photograph provided by the California Department of Transportation.

In towns and cities that have strictly adhered to the geometric dictates of the Township and Range System, its influence extends to all aspects of the human landscape. Even the smallest features such as town lots and the organizational geography of homes, yards, fences, and driveways in these communities are oriented to the straight lines of the survey system. Its impact is evident, as well, around the expanding margins of California's burgeoning cities. Cities grow at the expense of open countryside and in the process adopt the configuration of pre-existing cadastral patterns. In this fashion, urban boundaries spread along the edges of sectional roads before filling in the development tracts (Jordan 1982, 54). Moreover, land incorporated for urban expansion is usually acquired in rectangular units of varying sizes that is, in turn, a legacy of the survey's influence on ownership patterns. As a result, the distinction between new urban developments and the rural hinterland is often stark and delineated in conformance with the cardinal directions. The zones of suburban growth around downtown San Bernardino and Sacramento, for example, are distinct for their miles of rectangular blocks and uniform streets.

After dark, the rectangularity of urban lights is one of the most prominent and singularly striking patterns of California's nightscape. This nocturnal panorama is especially impressive from an elevated perspective offered by highlands or aircraft. Indeed, the westward descent into Los Angeles International Airport at night provides unsurpassed visual testimony to the sinews of the Public Land Survey.

San Francisco Takes Water From Lobos Creek, September 17, 1858

During the early years of the gold rush, San Francisco grew so rapidly that by 1852 it had outgrown its own local supplies of fresh water. In that year the city approved a petition to tap a source of permanent water from another drainage system. After several delays and changes to the original plans, in 1858 water was transported by flume from Lobos Creek five miles to the mains of downtown San Francisco (Delgado 1982, 31–35). On completion of the project, San Francisco became the first major municipality in California to receive a permanent water supply from another watershed. The tapping of Lobos Creek provided the precedent that inspired subsequent efforts to acquire more distant and widespread sources of fresh water by San Francisco and other urban areas throughout California (Figure 5). California's exceptional urban growth may be traced to it and few events have initiated processes more important to the shaping of the state's contemporary landscapes.

The Lobos Creek diversion and subsequent projects allowed San Francisco

to increase from a pre-gold rush population of 300 in 1846 to 80,000 by 1862. Additional water was again required, and the city expanded its infrastructure to impound and import more water, first from the peninsula to the south and then from the southern East Bay (Leonard 1978, 38–39, 42–43). By 1900, the city had reached a population of 340,000 and was now looking to the Sierra Nevada, and specifically the Tuolumne River, for additional sources (Hundley 1992, 120, 169–170). The lynchpin of the

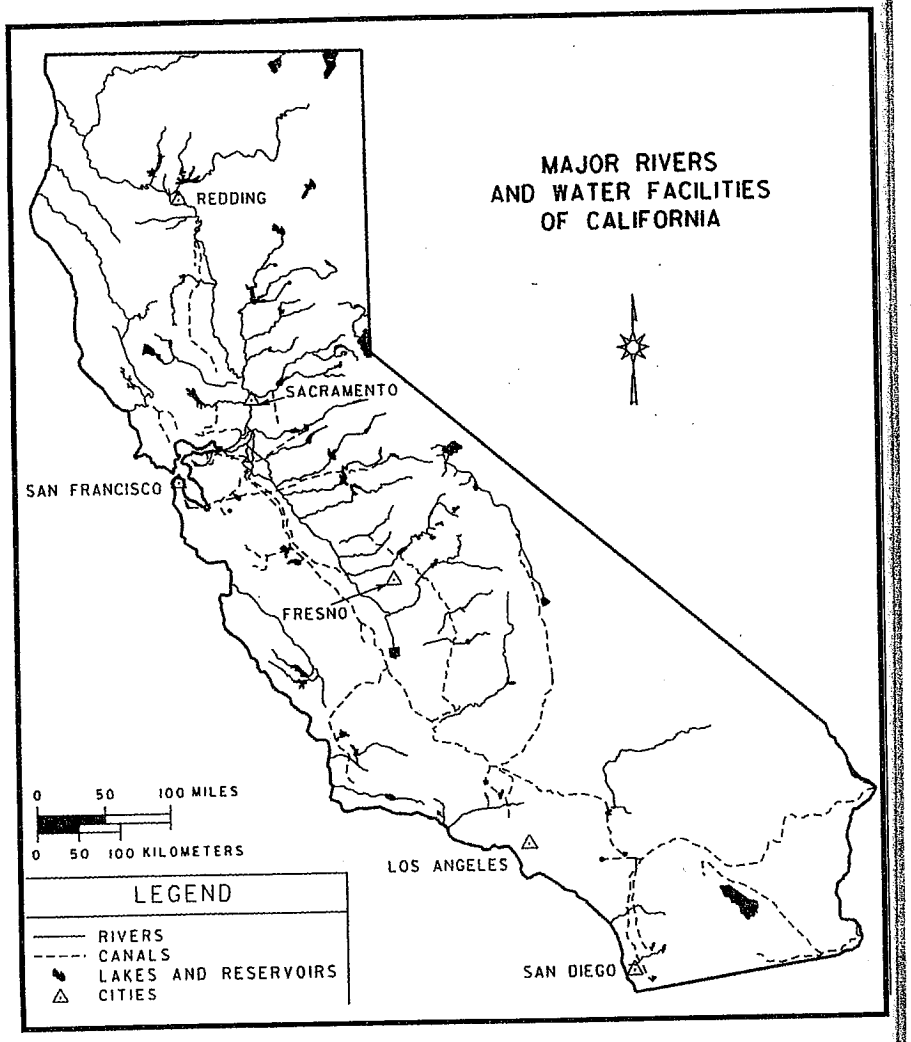

Figure 5.
The major federal, state, and local water transfer structures in California.
Source: California Department of Water Resources.
Cartography by Margarita M. Pindak.

Tuolumne system would be the damming of Hetch Hetchy Valley in Yosemite National Park (Kahrl 1978, 29–31; Brechin 1999, 71–117). After considerable controversy, San Francisco was victorious and by the early 1930s was importing most of its municipal requirements from the Tuolumne watershed through the 148 mile long Hetch Hetchy Aqueduct. For years following the initiation of the project the system continued to be upgraded with a spectacular array of tunnels, dams, pipelines, inverted siphons, and powerhouses.

Imported water provided San Francisco with the ability to modify national parks, national forests, cities, and farmlands. Reservoirs such as Hetch Hetchy, Crystal Springs, Don Pedro, and Calaveras cover hundreds of square miles, and the intervening landscapes are laced with pipelines, powerhouses, and transmission lines. Many of these facilities and their rights-of-way boast a variety of recreational functions including camping, hiking, boating, and fishing (Benchmark Maps 1998, 14–17). These attractions, in turn, have generated an array of business and administrative landscapes along access routes and within gateway communities. San Francisco's jurisdictional authority to dictate land use and management practices around the project's facilities is extensive. The city has considerable land and water rights in a number of peninsula and southern East Bay counties and county, state, and federal fiats guarantee its influence over other lands. One result of this control is maintenance of open space by the city in some Bay Area suburbs (Brechin 1999, 88; Leonard 1978, 24–25).

Although Tuolumne water temporarily renewed San Francisco's urban growth, further expansion was eventually curtailed more by political and physical constraints than by a lack of water. Nevertheless, the city's influence is still felt in its ability to control water resources and as a precedent for other metropolitan environments. San Francisco currently possesses substantial water and power surpluses and it sells the excess to nurture continued urban expansion in more than fifty neighboring communities. Virtually all of San Mateo County's residents, for example, depend upon water sold to them by San Francisco (Leonard 1978, 25; Selby 2000, 194). Additionally, the East Bay Municipal Utility District (EBMUD) mimicked San Francisco's urban water system and imported Sierra water from the Mokelumne watershed. This water in turn continues to fuel urban expansion in the vicinities of Walnut Creek, Concord, and Danville and the growth has inspired EBMUD to consider other distant sources such as the Feather River (Littleworth and Garner 1995, 9–10).

The urban water system in Southern California conforms to the overall pattern of San Francisco's diversion of the Tuolumne and the East Bay's