Introduction

by
W. Turrentine Jackson
Rand F. Herbert
Stephen R. Wee

I

Following the Civil War, many Americans, responding to the era's expansionist mood, expressed unbounded confidence in the economic benefits of rapid settlement of the West and in the region's capacity to absorb nearly limitless population. At the same time liberalization of public land disposal policies encouraged western migration. The future of California, which constituted much of the far West, lay in settling unclaimed public lands, redeeming its vast desert regions, and transforming the state into a home for millions. Irrigation was central to this vision. Little reliable or scientific information was available on the environmental problems that would confront farmers who came to conquer the arid West. In the 1870s many respected scientists, as well as western congressmen and town site boosters in semi-arid regions, still promoted the belief that "rain follows the plow."[1] However, it was the technological manipulation of water supplies that enabled the new West to blossom in the early decades of the 20th century. California's agricultural development was not a saga of individual enterprise but the story of people who built organizations and institutions to control a problematic environment through use of technology.

The increase in the number of engineers in California, from 6 in 1850 to 158 in 1870, is one indication of their expanding role in shaping California during the first decades of statehood. Engineers of the latter 19th century, writes historian Raymond H. Merritt, "often pictured themselves as the vanguards of civilization who stimulated intellectual thought and promoted the expansion of cultural values, as well as developing natural resources and fulfilling material needs." Civil engineers enjoyed a high professional status in America because of their ability to manipulate the environment. When leveling mountains, draining swamplands, irrigating deserts, bridging rivers, and designing safer and speedier transportation, engineers in the American West thought of their profession as the one most responsible for developing civilization on the frontier and for promoting better economic, social, and cultural institutions.[2]

By 1870 the great Central Valley of California had been opened to settlement for more than a quarter century. (*Map 1*) The region had about 15 million acres of land capable of producing crops given a proper system of reclamation and irrigation, yet only a few thousand people were engaged in cultivating the soil. Various reclamation and irrigation

projects in the 1860s failed to attract widespread or dense agricultural settlement, particularly in areas removed from the major navigable rivers of the interior valley. In 1871 Prussian-born journalist and author Charles Nordhoff described the San Joaquin Valley: "Wheat, wheat, wheat, and nothing but wheat, is what you see on your journey, as far as the eye can reach over the plain in every direction." The valley was still open range dominated by the "cattle kings" Henry Miller and Charles Lux and the interminable wheat fields of Frank Norris's Octopus. Small houses and barns were scattered at great distances. There were few small irrigation ditches and almost no fenced fields; towns were dusty roads lined with a few saloons. "Fields of two, three, and four thousand acres," observed Nordhoff, "make but small farms."[3]

Up until the late 1860s mining had dominated the economy of California, but between 1860 and 1870 the number of miners fell from 83,000 to 36,000. Agriculture had expanded and soon became the state's principal industry. During the same decade the number of farmers statewide increased from 20,000 to 48,000.[4] Many Californians foresaw that the future of their state lay in judiciously exploiting its vast plains and tule marshes by replacing local control and piecemeal development with more efficient and scientific planning. A permanent agricultural empire based on irrigation and export by ship and railroad would bring more order and control over violent fluctuations of the regional agricultural economy. In post-Civil War California, members of the State Agricultural Society, most of whom were affluent agriculturalists and proponents of scientific farming, stressed the link between transportation improvements and farm markets, land values, and population growth. Many who joined the organization favored corporate development of water resources; others wished to invoke the sovereign power of the government to plan or build the necessary public works. Both groups looked to the engineering profession to help capitalists or the state control the environmental forces threatening economic development of agricultural lands in the valley that was destined to become "the garden and granary of California."[5]

As early as September 1867 prominent farmers called for statewide action. Ex-congressman John Bidwell, a gentleman farmer and a Sacramento Valley resident since his arrival at Sutter's Fort in 1841, called for "a great design or system" to save the plains from destructive inundations. He asked that the state appropriate "vast sums of money" and hire "the best engineering talent in the country" to design an integrated system of mountain reservoirs, levees, drainage canals, and irrigation ditches to reclaim the swamps and irrigate dry lands throughout the valley.[6]

A veteran of the levee wars in the Sacramento-San Joaquin Delta, J. Ross Browne complained in 1872 that "the resources of a country are intrinsically valuable [only] in proportion to the facilities existing for their development." However, for more than twenty years, valley residents had remained generally apathetic about public improvements for flood control and irrigation. Without an organized effort to press for comprehensive solutions, numerous bills submitted to the state legislature had failed. Browne called on the legislature to establish a permanent commission, "to consist of at least three of the ablest engineers in the

country, whose duty it should be to make a thorough and comprehensive survey of all the lands in the state subject to overflow [and] to agree upon a system of irrigation, reclamation, and drainage."[7]

In his 1871 annual report to the governor, Charles F. Reed, president of the State Board of Agriculture, advocated a joint plan of reclamation and irrigation for the entire portion of the state lying between the Coast Range and the Sierra Nevada. Reed claimed that the longer the state delayed in formulating a general plan, the greater the difficulties in implementing one would become. Conflicting vested interests would result in "vexatious questions of water privileges" and "unfriendly contention and fruitless litigation."[8] The messages of Reed, Bidwell, and Browne bore a common theme: an appropriate system of water management might extend benefits equitably, but water distribution could not be left in the hands of ordinary people and a chaotic, decentralized population.

The heartland of California's agriculture since the last quarter of the 19th century has been its great Central Valley, comprised of four smaller interconnected basins known as the Kern, Tulare, San Joaquin, and Sacramento river valleys. Alluvial in origin, the Central Valley is bordered on the east by the lofty 400-mile-long Sierra Nevada and on the west by the Coast Range. The valley runs generally north-south for some 450 miles and has an average width of 50 miles. Its area encompasses roughly 25,000 square miles, or nearly 15 million acres of prime farmland. The Sacramento River, California's largest stream, flows southward through the center of the northern half of the valley; the San Joaquin River runs northward through the southern half. They meet in a vast delta region before discharging into Suisun and San Francisco bays. Some ten smaller tributaries flow out of the Sierra Nevada, cutting through the eastern side of the valley before emptying into the two great rivers. Before the irrigation age began, in the extreme southeastern corner of the valley the western-flowing Kern, Kings, and Kaweah rivers emptied into low basins. These formed three huge seasonal lakes -- Kern, Buena Vista, and Tulare -- that covered some 750 square miles during the wet season. With the exception of Cache Creek and Stony Creek in the Sacramento Valley, on the west side no major streams flow into the valley from the Coast Range.

Because rainfall in the Central Valley is unevenly distributed, much of the land was vulnerable to periodic floods and acute drought. Hence, water engineers sought to devise a hydraulic system for equitably distributing winter rains. With such a system, farmers could have all the water required in dry seasons and protection against overflow in seasons of flood. Population growth and economic development hinged on storage, diversion, and redistribution of water on a scale unprecedented in the United States. However, large water projects require considerable start-up capital and the history of large irrigation enterprises indicated that they were generally unprofitable as corporate ventures. Irrigation promoters wrestled with ways to raise funds to develop water projects in isolated, rural areas on the far western frontier. They had to find institutional structures; private organizations; or local, state, territorial, or

federal agencies to plan, build, and operate complex, multifunctional water projects on a sound engineering basis.

Government-financed irrigation and reclamation systems in the highly centralized "hydraulic societies" of Egypt, Italy, India, and China where more sophisticated irrigation institutions had evolved attracted the attention of American engineers and scientists, progressive farm organizations, and the Republican leadership in California during the late sixties and early seventies. Proponents of Old World irrigation methods rarely noticed the ecological problems that technology created, the disastrous effect on native cultures, or the antidemocratic forms of social organization associated with the control of water in foreign countries. Instead they viewed the ancient hydraulic civilizations as useful technological models of how to manage natural resources and create opportunity for millions of autonomous individuals who could never conquer the arid western desert alone.[9] Those advocating centralized control did not go unopposed. Grass-roots organizations of small farmers, who had their own vision of farm life grounded in republican agrarianism and whose political influence peaked in the antimonopolist fervor of the 1870s, challenged the outlook of the "elite" farmers. In California a weak administrative apparatus for governing water rights combined with economic, political, and ideological conflicts to make water management policy a battleground in the last half of the 19th century and beyond.[10]

The need for water storage and irrigation in the arid West was just beginning to capture the nation's attention in the 1870s. Knowledge of western climates and soils was rudimentary at best. Nobody knew how much land was irrigable or whether enough water was available to make irrigation profitable. Over the ensuing decades water became the critical issue in the American West. How much irrigation water went with the land, the number of acre feet required to raise crops, and the cost per acre foot became the most important factors to be considered in deciding where to farm. With guarded optimism the federal government began studying the potential of western irrigation. An act of Congress in 1873 authorized an investigation to ascertain the extent to which the great Central Valley of California could benefit from a comprehensive system of water conservation and management that would store flood waters, enhance inland navigation, and provide water to irrigate millions of acres. Although two of the three persons on the resulting commission were military engineers trained at West Point, the commissioners did not have extensive experience in river management, dam building, or constructing irrigation systems. Nevertheless, these "functional intellectuals" undertook the work with the confidence and authority that typified their profession. In doing so, they cultivated an image of responsible and utilitarian public service.[11]

The Irrigation Commission lacked fundamental information about the natural environment, knowledge absolutely essential to planning a comprehensive system of reclamation and irrigation. The commission's initial work consisted principally of an old-style military reconnaissance and collection of basic data heretofore unpublished on the topography, climate, precipitation, soil conditions, extent of irrigable and reclaimable land, water supply, and general hydrological characteristics of the

valley basins. Much of this information came from California state surveys of the west side of the Sacramento Valley, San Joaquin & Kings River Canal and Irrigation Company irrigation surveys in the southern and western portions of the San Joaquin Valley, and the Southern Pacific Railroad surveys down the east side of the San Joaquin Valley to Bakersfield.

Because of limited time and funding, the commissioners hastily conducted their field work in a matter of months. It was more like a preliminary examination than a detailed scientific investigation. Nevertheless, the commissioners developed a comprehensive scheme for building storage and diversion dams, proposed a system of canals and levees, and concluded that the problems associated with unreliable rainfall could be overcome through flood control and irrigation without damage to the navigation interests of the region. The report was so broad in scope as to be visionary. It captured the imagination and respect of engineers, businessmen, and political leaders throughout the state and nation. The conclusions reached by the commissioners, and their recommendations, remained significant contributions to future planning for development of the Central Valley and its water resources. Although environmental misconceptions and engineering flaws precluded the use of the report as a blueprint for future work in the 20th century, the report was an important addition to the scanty literature available to American engineers on planning and building irrigation projects in arid regions.[12] The commissioners realized that irrigation was neither cheap nor an inexact science; farmers could not simply go out, dig a ditch, and watch the water flow onto their fields. The commissioners recommended complete hydrographic surveys to determine the amount of water available in each river basin and detailed topographic surveys to determine the best location for the main canals and lateral ditches before construction of major irrigation or reclamation works. They realized this work might require decades of study. In the interim, the commissioners suggested that regions sufficiently populated should undertake irrigation work on a small scale, but only if consistent with the long-range general plan.

Sixty-five years after the work of the Irrigation Commission was completed California State Engineer Edward Hyatt, father of the State Water Project, assessed the effect of the commission's report on state water policy, water engineers, and California's water management bureaucracy in a 1939 national radio broadcast on California's agricultural program. The Central Valley Project, the centerpiece of California's massive hydraulic system, he stated, was "conceived as a dream as early as 1873." Hyatt credited the members of the federal Irrigation Commission with carrying out "one of the earliest attempts at water resources planning on a regional scale comprehending all needs of water regulation and utilization." The first state water agency, the State Engineers Office, labored from 1878 to 1888 to implement some of the basic recommendations suggested by the commission. During the 1920s and 1930s the Division of Water Resources, together with the Bureau of Reclamation and the Corps of Engineers, invested millions of dollars to perform the studies necessary to formulate a technically and economically feasible plan to irrigate and reclaim the Central Valley on a scale similar to that proposed by the Irrigation Commission more than 60 years earlier.[13]

II

During the last third of the 19th century, federal, state, and territorial officials confronted multiple problems in settling the American West. One related to the interlocking problems of water distribution and the disposal of public lands. In California three conflicting water rights doctrines had evolved to meet particular local needs: the tradition of community control as exemplified by pueblo water rights and by local water commissions in the southern counties of the state; the doctrine of prior appropriation growing out of local mining customs in northern California; and the common law principle of riparianism that recognized the usufructuary rights of landowners adjacent to a stream to divert water for their own use. The system of community control over water rights survived for decades in some southern California communities, but elsewhere in the state the power of private water companies became dominant by the 1870s. The *laissez-faire* doctrine of prior appropriation, recognized in the 1872 water code and protected by judicial decisions, encouraged corporate irrigation enterprises to make expansive claims to the waters flowing in California streams to the limit of the supply.[14]

The shape of the arid agricultural society built on irrigation depended as much on land settlement patterns and federal land policy as on water rights. By the 1870s Californians had reason to worry about the threat of a land and water monopoly. In the 11 leading agricultural counties 100 landowners controlled over five million acres. The Central Pacific Railroad owned another three million acres in California granted to them by the federal government. In 1870 the railroad magnates, under the guise of a second railroad company, the Southern Pacific, rushed to build a branch line down the unsettled east side of the San Joaquin Valley. The project brought lucrative revenues from shipping wheat and through acquisition of hundreds of thousands of acres of grant lands. Laid out along the major streams of the Central Valley, some 70 Mexican land grants -- comprised of tens of thousands of acres each -- had become large cattle and wheat ranches. During the 1860s a large share of the San Joaquin Valley's previously unclaimed grasslands fell into the hands of a few shrewd land speculators. An estimated eight million acres of public land in California passed into private hands during this decade. A considerable part was fraudulently obtained under federal legislation limiting grants to 160 acres and under liberal swampland disposal policies of the state of California.[15]

For the most part during the 1860s, these land grants and the federal subsidies extended to the Central Pacific Railroad were considered appropriate financial assistance to promote immigration and the economic growth of the state. By the 1870s, known as the "Terrible Seventies" in California, the economic and social benefits had not materialized and opposition grew to government aid of this type. Tales of outrageous construction profits, fraud, bribes to public officials, fraudulent affidavits, and graft by government inspectors were covered widely by the press and became major issues in the state and national elections of 1872.[16]

Many of the bonanza wheat men who owned vast tracts and looked on farming as a speculative venture were reluctant to invest in canal building. Between 1868 and 1873 California suffered a prolonged drought. Wheat crops failed completely in some years and in others yields were light. Small farmers throughout the valley who had bought farmland at inflated prices during the boom suffered severe hardship. Herdsmen fled the region with their stock, and farmers located near streams hurriedly formed irrigation companies to save their crops. One observer in the San Joaquin Valley in 1872 estimated that local farmers had constructed from 40 to 50 irrigation ditches in the past few dry years and were irrigating approximately 100,000 acres, some of the acreage planted in corn, cotton, flax, and barley. With few exceptions these ditches, built by hand by individuals or small associations of farmers, were ephemeral enterprises that quickly failed altogether or required substantial reconstruction between irrigation seasons. They were expensive and impractical solutions except under the worst drought conditions.[17]

After the Civil War, San Francisco capitalists with experience in forming municipal water companies and in supplying the hydraulic mines with water showed some interest in the commercial building of canals and ditches for irrigation. The actions of these urban capitalists, with their imaginative and bold schemes for reclamation and irrigation of large tracts of desert land, led circuitously to the appointment of the Irrigation Commission.

John Bensley launched the first major corporate irrigation venture in the San Joaquin Valley. In 1848 Bensley arrived in Sacramento and bought half-interest in two steamboats engaged in the Sacramento River trade. After the great Sacramento fire of 1852, Bensley moved to San Francisco. There he helped found the California Steam Navigation Company, a joint stock venture that controlled the bulk of the river traffic on the Sacramento and San Joaquin rivers until it sold out to the railroad. During 1857 he also organized the San Francisco Water Works Company to provide municipal water to that city. He remained president of the company until its consolidation with the Spring Valley Water Company a decade later. In the mid-1860s, when San Francisco began seeking new sources of water to meet its expanding needs, Bensley planned to bring water more than 100 miles south to the city from Clear Lake in Lake County. His plan never materialized; the Spring Valley Water Company developed reservoir sites southwest of the city in San Mateo County instead.

On 7 March 1866 Bensley organized the San Joaquin & Kings River Canal Company to irrigate land with water claimed under a notice of appropriation he posted on the San Joaquin River at Firebaugh's Ferry. After laying out a right-of-way, he began building the canal with his own capital. To demonstrate the practicality of irrigating wheat and barley crops in the San Joaquin Valley, he leased farmland along the canal route and put it into cultivation. Unable to attract sufficient investors in California, in 1867 to 1868 Bensley went to New York seeking financial support. He failed there also and was forced temporarily to quit work on the canal in 1868. In the spring of 1871 Bensley renewed his efforts, employing 1,000 Chinese laborers who managed to complete 40 miles of the canal.[18]

The high costs of labor and of transporting equipment and supplies 75 miles through the Coast Range and across the plains drained Bensley of capital. He turned to his old friend William Ralston and the Bank of California for help. Ralston organized a group of San Francisco capitalists who took over Bensley's irrigation scheme and incorporated in May 1871 as the San Joaquin & Kings River Canal and Irrigation Company. The company was capitalized at $10 million and included some of the most powerful financial interests in San Francisco: William S. Chapman, Lloyd Tevis, Isaac Friedlander, Henry Miller, Charles Lux, J. Mora Moss, and Nicholas Luning. Each of these men had extensive property interests in the San Joaquin Valley adjacent to the right-of-way for the proposed canal. Eventually Ralston hoped to build a second irrigation and navigation canal through the Sacramento Valley.[19]

The directors of the canal company hired a young British civil engineer, Robert Maitland Brereton. Brereton had exceptional administrative skills honed in India between 1856 and 1870 on the practical engineering work he carried out on the British government's transportation and irrigation projects. The British hydraulic engineering works in India included several huge dams and canal lines designed to irrigate an area in excess of ten million acres. The British built 6,000 miles of canal, of which 2,300 were navigable, and 18,000 miles of distributing lines. Having worked on these projects as a construction engineer, Brereton seemed extraordinarily well prepared by training and experience to take on the challenges of conquering the desert and building an irrigation empire in the San Joaquin Valley.[20]

Brereton came to the United States with an established standing in British society, prepared to meet influential dignitaries on the East Coast. Letters of introduction from the Secretary of the Institution of Civil Engineers in London, the Secretary of State for India, and the Secretary of State for Foreign Affairs gave him access to the leading civil engineers; military officers and public officials in Washington, D.C.; financiers in New York and San Francisco; and some of the most important railroad entrepreneurs of the era. After a few months on the East Coast, he traveled by train to San Francisco and then proceeded up the Pacific Coast studying the route and resources adjacent to the Northern Pacific Railroad in Oregon, Washington, and British Columbia.[21]

Brereton arrived in San Francisco in the summer of 1871. There he met William Ralston who hired him to work on his irrigation and mining ventures on the Pacific Coast. The board of trustees of the San Joaquin & Kings River Canal and Irrigation Company appointed Brereton as chief consulting engineer at a generous salary of $1,000 per month in gold. Departing for the valley immediately thereafter, Brereton inspected the work already accomplished and conducted preliminary surveys of the west side of the valley between Banta Station and Fresno in the fall of 1871. Although a drought had made the plains "a mere dusty desert," Brereton reported that irrigation would render the region suitable for wheat, corn, sugar beets, cotton, tobacco, hemp, ramie, and other products. The hot wind, dry climate, and dusty soil reminded him of the valleys of India before irrigation. These conditions, predicted Brereton, signaled a bright future for the region as "one of the richest and most productive valleys in the United States."

The San Joaquin & Kings River Canal and Irrigation Company had already begun work earlier in the year on a 40-mile stretch of canal from Fresno Slough to Los Banos. An experienced professional civil engineer, Brereton was a harsh critic of haphazard and inefficient irrigation developments. In his initial report to the board, he complained to canal company officials that shoddy work by his predecessor had not been based on any instrumental survey or comprehensive plan. Furthermore, the work was unsuitable to meet the irrigated acreage projections or the navigation requirements of the company. The canal as constructed was useful only for local purposes and would irrigate less than one-third of the acreage contemplated. Furthermore, the high velocity of the water precluded upstream navigation. He advised the trustees to consider a more comprehensive project to irrigate the entire valley below Tulare Lake, but expressed concern about earning the cooperation of landowners, the rate of settlement on farms within the irrigable area of the proposed canal, and potential legal battles with those holding riparian rights to water.[22]

The board responded by ordering Brereton to prepare a more comprehensive report on a "complete system of irrigation for the San Joaquin valley, from the foot of Tejon Pass to the delta lands of the San Joaquin river around Antioch." The area covered nearly eight million acres, including hundreds of thousands of acres of marshlands that could be purchased without any acreage restrictions at the cost of reclamation under the 1868 state swamp and overflow land disposal act. Brereton recommended that the company build large storage reservoirs on the Kern and Kings rivers and file claims to appropriate all the unappropriated waters on these streams together with those of the other smaller tributaries draining into Tulare Lake. Two canals from the Kern River above Bakersfield and one from Kern Lake would irrigate 640,000 acres in Kern County. Any surplus water would be stored for irrigating lands from the main headgates at Tulare Lake by embanking Kern and Buena Vista lakes and connecting them with Tulare Lake by dredging existing overflow channels. The cost for this portion of the work was estimated at $3,500,000; the annual value of crops grown in the same region was ultimately expected to be $21 million. Assuming farmers were willing to pay $1.25 per acre for irrigation water for each crop and fees for water for grazing and domestic purposes, Brereton calculated the company could obtain a minimum of $800,000 in revenue from water sales each year once the irrigated lands were fully settled.

In the vicinity of Tulare Lake, Brereton planned to levee the eastern, southern, and southwestern shores, thereby reclaiming 207,000 acres of swamp and overflow lands on its borders. Two hundred miles of levee along the lower Kings River, Fish Slough, and Fresno Slough would control floods and channel water from the northern outlet of Tulare Lake to the San Joaquin River, reclaiming another 100,000 acres of prime agricultural land. Storage reservoirs and distributing ditches in Tulare County in the vicinity of Visalia and Centerville would irrigate approximately 800,000 acres. Nearly all the irrigable land on the west side of the valley from Summit Lake to Antioch, some 500,000 acres, would be irrigated from the main 160-mile-long canal, diverting 2,500 cubic feet per second from Tulare Lake. Brereton estimated the total cost for these elements of the project at $2.6 million and annual revenues at $750,000 when farmers settled all the irrigable land.

Finally, Brereton contemplated building levees on both sides of the San Joaquin River from Millerton to Hill's Ferry, a distance of 90 miles, to reclaim about 276,000 acres of swamp and overflow lands. By damming the San Joaquin above Millerton, tunneling through Table Mountain, and carrying the water in a flume to Jones' Ferry then north 80 miles along the foothill contour, 400,000 acres could be irrigated on the east side of the valley between the San Joaquin and Merced rivers at a cost not to exceed $2 million. Brereton's investigations did not extend north beyond the Merced River.[23]

By 1871 and in the middle of a horrible drought, Fresno, Tulare, and Kern county farmers had experimented sufficiently with building irrigation works to recognize the potential value of water conservation and irrigation during dry years. Their experiments had also taught them that constructing headworks, canals, distribution ditches, and levees required substantial capital and engineering skill. Brereton's plan to centralize and scientifically develop irrigation works caught the imagination of farmers everywhere in the valley, but public reactions were mixed. Many applauded the plan because the canals would bring water to dry lands and provide a measure of flood control, and because Brereton had designed the main and major branch canals as a water carriage system for barges. Cheap water transit from fields to the grain ports of Antioch and Martinez might restrain the power of the railroad and lead to lower freight rates. Furthermore, the canals could facilitate movement of coal, lumber, salt, and farm implements upstream to valley communities. However, fear of a land and water monopoly in the San Joaquin Valley soon remolded public opinion.[24]

The San Joaquin & Kings River Canal and Irrigation Company owned none of the lands subject to irrigation from its canal system. However, the company had secured appropriative water rights under state law and purchased rights-of-way from private landowners, many of whom were shareholders. Naturally, the company wished to acquire private lands at preirrigation value. Once reclaimed and irrigated the land would escalate in value to $25 or $30 per acre, or could be rented at $4 to $5 per acre and held until cultivation, improvements, and settlement raised the value. The project promoters also hoped to acquire vast tracts of fertile land adjacent to rivers and streams from the state as swamp and overflow land grants and from the federal government as subsidy grants in the form of alternate sections of public land along the canal route. If the company could not acquire land by these methods, it would be necessary to recoup its entire investment through per-acre fees for the delivery and use of water and from transportation charges. Brereton and Ralston realized that the latter arrangement would not be profitable for investors. Those who stood to gain most were the owners of lands to be irrigated -- Henry Miller, Charles Lux, William S. Chapman, Isaac Friedlander, Timothy Paige, and T. Grayson -- whose property might increase in value tenfold when irrigation water became available.[25]

Ralston and the trustees of the San Joaquin & Kings River Canal and Irrigation Company petitioned the legislature in January 1872 to memorialize Congress for a land grant.[26] Ralston anticipated the support of Governor Newton Booth, who had been elected in 1871 on the Republican

ticket but who had also taken a stand against subsidies to the railroad. After he became governor, Booth began to fashion a new political machine, the People's Independent Party, to address the concerns of the emerging farm bloc in California politics. By 1873 he was identified as a champion of the small farmers' cause and was backed strongly by the Patrons of Husbandry, a farmers' organization opposed to monopolies, control of water resources by large landowners, government corruption, and high freight rates. Booth and his political followers favored strict government control of railroad and steamboat transportation, public utilities, and natural resources. The new party distrusted the alliance of land monopolists and civil engineers. Booth desired that the valley's irrigable land be developed by sturdy American yeomen and that local associations comprised of farmers cooperate in irrigating their lands. Branding Brereton a British adventurer, Booth questioned his reputation and his credentials for designing and constructing the colossal system. Booth also attacked the company's colonization program and water distribution system as "utterly utopian."[27]

Having failed to attract the support of either the state or private investors, Ralston hoped to raise capital in England. In May 1872 Brereton traveled to London to solicit capitalists willing to form a syndicate to provide funding. He carried endorsements from Ralston, former governor Henry H. Haight, the British consul, an agent for the Rothschilds, and 13 prominent businessmen in California. Ralston's Bank of California was heavily indebted to its London agent, The Oriental Bank, and money was tight everywhere in Europe. On 17 July 1872 Brereton wrote to Ralston of his failure in England because "no one believes in California projects." They were all branded as speculative, badly managed, and "not solid, moderate investments." Although he returned without any capital, Brereton did secure promises from a dozen potential investors that they would visit California in March 1873 to see the enterprise with the intention of investing if sufficiently impressed. Brereton pledged to remain in California for ten years as trustee and agent if they backed the project.[28]

Against this background, in February 1873 Ralston sent Brereton to Washington, D.C., to discuss with President Grant, his cabinet, and members of Congress the importance of irrigation in the arid West. While he was on the East Coast, Brereton hired Samuel Ward, a forty-niner and cousin of the famous San Francisco McAllisters, to help him guide the San Joaquin & Kings River Canal and Irrigation Company's measures through Congress. Ward was celebrated in the decade following the Civil War as "The King of the Lobby" for the dinners he arranged between clients and members of the executive branch or chairmen of strategic legislative committees. During the sixties, the Republican Party had controlled Congress and had drafted a blueprint for developing a new America that strengthened political bonds and economic ties with the West. At that time, Ward represented California gold-mining interests, land speculators, railroad promoters, and financiers in the stocks and bonds market; those who were the primary beneficiaries of new transportation, public land, and currency legislation.[29] Writing 25 years later, Brereton remembered Ward as a "genial and kind hearted man." "He helped me greatly in my mission and was

my *chaperone* and right hand at the several dinners I gave to the members of Congress and others," he recalled. "This was my only expense I [*sic*] incurred during the six months I remained in Washington on this mission."[30]

The lobbying activities of Ward and Brereton and the support of the California delegation could not garner enough votes in the 1873 congressional session for the San Joaquin & Kings River Canal and Irrigation Company's entire legislative package. The Republican Party had split in 1872, with a substantial segment bolting to the Liberal Republican Party for diverse reasons including opposition to corruption and further land grants to corporations. In addition, Governor Booth's antisubsidy and antimonopoly forces in California opposed any federal assistance to the canal company through grants of public lands. The Senate and House Committees on Public Lands had gone on record against further disposal of public lands as subsidies for railroad construction and were understandably reluctant to provide these incentives to canal companies.[31] While in Washington, Brereton lobbied for two separate but related pieces of legislation. One was purely a special-interest item aimed at obtaining a federal land grant for Ralston's company to encourage construction of a canal for irrigation and navigation in the Central Valley. The second item enjoyed broader appeal. It sought a modest appropriation for appointment of a board of commissioners to report on a system of irrigation for the San Joaquin and Tulare valleys.[32]

Republican Senator Cornelius Cole of San Francisco, who four years earlier had unsuccessfully carried a bill in the Senate granting alternate sections of public land to the Sacramento Irrigation and Navigation Canal Company, introduced the subsidy bill on 17 January 1873. The measure was referred to the Senate Committee on Public Lands. On 10 February 1873 Republican Congressman Sherman O. Houghton of San Jose introduced the same bill in the House. The bills provided for a subsidy to the San Joaquin & Kings River Canal and Irrigation Company for building an irrigation and navigation canal diverting the waters of Buena Vista and Tulare lakes and San Joaquin and Kern rivers by canal along the east slope of the Coast Range to Antioch and then to Oakland at a terminus 125 feet above sea level. The bill provided that the government would grant to the company two sections of public land per mile, a right-of-way 300 feet wide on each side of the canal through public lands, and a 100-foot right-of-way on feeder lines and side ditches.[33]

On 14 February the Sacramento Bee went on record opposing the "Houghton" canal legislation.[34] A bill to encourage irrigation in the valley would benefit future inhabitants, wrote the Bee. However, conditions in California offered considerable cause for alarm. The preponderance of farmers working in the Central Valley did not own the land. It belonged to Friedlander, Chapman, and other speculators who would perpetuate their holdings through the canal subsidy. The newspaper was more troubled by the link between aridity, water control, and social power: "They have monopolized the land, and now they want to monopolize that other great element of life, water -- and having the water of the San Joaquin Valley in their control, they would rule it forever." The Tulare Times inveighed against the twin evils of land and transportation monopoly. If

the canal subsidy passed, the "land sharks" and the railroad would battle each other for "the power to crush and rule this portion of the valley."[35]

The Sacramento Union opposed reclaiming the desert through concentrated capital because of the effect of corporate farming on the rural social structure in California. The Union lashed out at the "non-resident proprietors" living in London, Paris, New York, or San Francisco who held back the progress of the valley by farming in the "Arab method" with a large work force of cheap seasonal labor.

> In the spring and winter they erected tents to accommodate the plowmen, after seed is deposited tents are struck and the workmen all vanish. Desolation reigns until harvest time, when the tents reappear, and for two months more there are signs of busy life, and then another exodus of laborers.

These farming methods brought on conditions that were antithetic to the Union's vision of the ideal countryside: a diversified agricultural region dotted with small farms, schoolhouses, libraries, churches, decent roads, and prosperous towns. To enrich urban capitalists who would "fix upon California the system of non-resident proprietorship of English landlords in Ireland," absentee owners and speculators were asking the U.S. government for $10 million to $30 million in public lands and water rights. In turn, millions of acres of desert would be transformed into gardens and granaries ruled by distant corporations. Irrigation was still a novelty for westerners and its effect on society was unknown. The editors of the Union remained confident that a wise public policy would enable local communities to conquer the desert through irrigation. If family farmers could gain access to irrigable tracts of the state's most arable land, a more perfect agricultural economy and rural society dominated by men and women of modest means would result. Recognizing that farming had social ends as well as economic means, J. D. Spencer, editor of the Stanislaus County News, cautioned his readers that while federal assistance for western irrigation enterprises may seem desirable, any special grants had to safeguard the rights of the individual farmer and preserve the family farm.[36]

In February 1873 the San Francisco Chronicle, the only major paper to support the subsidy, stated that the desert could not be redeemed without government assistance and concentrated capital investment by corporations. The proposed canal would benefit the entire region by ensuring good annual crop production and cheap freight rates. The Chronicle claimed the legislation provided for use of the streams to enrich and fertilize the barren plains that, when irrigated, would attract "first-class immigrants" from other farming regions in the eastern states and Europe. While the plans for transformation of the agricultural economy of the region had been formulated by capable leaders of California industry and under the direction of an experienced engineer who had helped build the great irrigation systems of India, the Chronicle observed that the undertaking could never be profitable without the land grant subsidy.

Monopoly had to be controlled, but the subsidy bill would enable the company to offer its bonds on the European market, acquire financing cheaply, and speed the project to completion. Any scheme that attracted foreign investment to develop the state's natural resources was worth considering. "Just because the men advancing it are rich capitalists doesn't mean it won't develop commerce, promote California industries and property, and add greatly to the wealth and population of California," insisted the Chronicle. The introduction of corporate irrigation enterprises to the valley, the editors of the San Francisco paper believed, would not necessarily create a rural class structure that could threaten the democratic values of the American frontier.[37]

The Senate Committee on Public Lands refused to report the bill to the floor without substantial modifications. On 2 February 1873 Senator Cole wrote Ralston that he had been pushing the irrigation bill in committee hoping to have it reported. He had testified personally before the committee and had scheduled Brereton for a hearing. However, Cole confessed that even with western irrigation enthusiasts Senator William Stewart of Nevada and Senator Eugene Casserly of California sitting on the committee, "chances for success in this session are not bright."[38] Two weeks later George C. Gorham, Secretary of the Senate, complained to Ralston that a few unnamed "personally and politically offensive" men were blocking the bill. He had done everything possible to assist Brereton, but the promoters of the canal enterprise would have to settle for "a partial result." Gorham wrote Ralston that an irrigation commission might be created "to give assurance to the most prudent that the future would bring all desired national aid to the noble enterprise the company had undertaken." Nothing further could be accomplished with respect to the subsidy legislation during the 1873 session.[39]

According to articles in the Sacramento and San Francisco newspapers, the final bill as amended in committee made no mention of Buena Vista Lake, but granted the company the right to appropriate the waters of Kern and Tulare lakes. The bill dropped the Kern River from its list of streams but added Kings River and its tributaries along with the San Joaquin River "and other small streams as may be available." Land grants in the public domain for reservoirs to store water and enhance navigation were limited to a maximum of 100 acres for each 10 miles of canal. The bill retained its original features as to disposal of public lands as grants, but restricted the benefits to the company to cash proceeds of actual sales "to be paid upon completion of sections five miles in extent." The modifications also restricted distribution of water to bona fide settlers and set maximum charges for that water at $1.25 per acre. The state of California was empowered to regulate all other rates and tolls associated with operating the navigation and irrigation canals. Finally, the property granted to the canal company would be subject to state taxation. Senator Casserly, a member of the Committee on Public Lands, was reported as the author of the amended bill.[40]

Even with these compromises to safeguard the public interest, Congress remained reluctant to act on any measure that granted more than 250,000 acres of land and exclusive water rights to a private company without more study. Just four days before Congress was scheduled to

adjourn, Casserly announced that his committee did not intend to put the bill up for a vote during the 1873 session. However, the committee members agreed to print the bill, an outline for federal assistance for irrigation development of the American West, as amended by Casserly. This action enabled congressmen and senators to study the proposed bill during the congressional recess because, Casserly noted, "the subject to which it relates is substantially a new one in the legislation of Congress." Speaking before the Senate, Casserly stated that irrigation had become the pivotal issue in the economic development and rapid settlement of the arid western states, for without irrigation great regions of arable land would remain barren in California and other western states and territories. The subject demanded immediate congressional attention. Casserly intended to fight for passage of special legislation on behalf of the irrigation and canal company during the next congressional session that would give all the federal aid possible to the company while providing "the proper guards for the general interests."[41]

Throughout the following summer, citizens discussed the propriety of federal subsidies for private canal ventures at public meetings and political conventions throughout the northern half of the state. The subsidy bill was strongly opposed by farm clubs, the Patrons of Husbandry, and newly organized chapters of the California Grange. Major valley newspapers joined the assault on the San Joaquin & Kings River Canal and Irrigation Company, urging no further land or water grants. Yet these same groups desperately wanted irrigation in the Central Valley. Unlike the subsidy bill, the bill to provide for a Board of Irrigation Commissioners to study the feasibility of irrigation in the Central Valley was applauded by small farmers, state agricultural organizations, and public officials. Before giving grants to private citizens, wrote D. M. Adams of the Tulare Times, state and federal engineers should make scientific surveys and study the available sources of water. The government then could act to prevent water monopolies. If, as the capitalists contended, high cost estimates mandated incentives to the builders of artificial waterways, the rights of the people to equal enjoyment of nature's bounty needed to be protected by state intervention and regulation.[42]

Senator Stewart of Nevada, sometimes known as the third senator from California because of his conspicuous service to the monied interests of the state, introduced the bill to form the Board of Irrigation Commissioners. What Stewart proposed, wrote the editor of the Sacramento Union, was to let government scientists and engineers identify the best irrigation prospects and then open them up for private exploitation. The newspaper claimed that Stewart's bill "looked toward construction of a system of irrigating canals in the San Joaquin Valley at government expense." Why was Ralston's old friend, "the sage-brush senator," sponsoring the bill when California had its own senators and the project was wholly within its borders, questioned the Union.[43]

The bill, referred to the Committee on Public Lands, authorized a study of the San Joaquin and Tulare valleys only. Sacramento Valley interests protested and asked Congress to have the commission also look into a comprehensive system to reclaim the three million acres of swamp and overflow land in the state. According to the Marysville Appeal, the present

system whereby local reclamation districts erected higher and higher levees to repel flood waters was inadequate. Proper drainage and irrigation of the valley required canals to relieve the main streams of some of their water and to provide more direct outlets to San Francisco Bay. If the commission was to study irrigation in all its aspects, drainage and reclamation studies were essential. Senator Casserly reported the bill out of committee on 14 February with an amendment extending the duties of the Irrigation Commission to include an irrigation survey of the Sacramento Valley. However, the requested study of reclamation and flood control problems was not authorized. On 17 February Congressman Sherman O. Houghton of San Jose brought the bill before the House, where it was referred to the Committee on Public Lands. Casserly's amendment and news that the subsidy bill would fail appeased some opponents of the Irrigation Commission bill. The Sacramento Bee praised the bill as one that might "confer lasting benefits upon California." Although the Sacramento Union remained skeptical of Stewart's motives, it termed the bill "comparatively harmless . . . if not followed up by supplemental schemes for subsidy in connection with another and far different bill introduced by Houghton." The Union reminded its readers to remain vigilant, for the subsidy bill would be revived during the next congressional session.[44]

On 28 February the bill creating a Board of Irrigation Commissioners to investigate the Central Valley went before the full Senate. The bill met with only token opposition from Senator Lyman Trumbull of Illinois, who expressed concern that when the commission submitted its report to Congress the next year, its recommendations and cost estimates might be translated into an appropriations bill of as much as $500,000 for construction of an irrigation system in the Central Valley. Senator Cole denied that such aid would be requested. Stewart assured Trumbull that the bill was not intended as a preliminary survey aimed at securing federal appropriations for construction. However, he did concede that the federal government might be expected to grant a right-of-way over public lands for a private irrigation enterprise. Casserly dismissed Trumbull's fears by noting that the survey would take less than a year, cost less than $6,000, and provide for only a preliminary examination. The bill easily passed in the Senate and went before the House on 3 March, the last day of the session. With the sanction of the House Committee on Public Lands, it moved swiftly through the House and passed by a margin of two to one.[45]

III

Congress specified in the act that the President was to assign two Army Engineers and an officer of the Coast Survey to the Irrigation Commission. They could "associate themselves" with two persons not in federal service. One was to be the state geologist of California; the other a "civilian distinguished for his knowledge of the subject." The five-person Board of Irrigation Commissioners was to make "a full report to the president on the system of irrigation" of the Sacramento, San Joaquin, and Tulare valleys. The board also was to provide maps, plans, and engineering or other statistical details as necessary. The President then would send recommendations to Congress. The Secretary of War was

ordered to provide subsistence and transportation for the board. The act specified that federal commissioners were to draw their normal salaries, while the nonfederal members were allowed a fee of $2,000 each.[46]

President Grant appointed two Army Engineers who were stationed on the Pacific Coast, Lieutenant Colonel Barton Stone Alexander and Major George H. Mendell. Brigadier General Andrew A. Humphreys, the Chief of Engineers, welcomed an expanded role for the federal government and the Corps of Engineers in developing the natural resources of California and in creating an irrigated agricultural empire on the Pacific Coast. In congressional testimony, he personally supported passage of the bill creating the commission.[47] Humphreys notified Alexander on 12 April that Professor George Davidson would represent the Coast Survey. He told Alexander to convene the board in San Francisco, or some other convenient place, and to proceed with field work as soon as practicable. Humphreys also requested monthly reports on the commission's progress. Once field work was complete, the commission was to write a report for the Secretary of War, if possible before 1 December 1873. Although Congress had set a salary cap for civilian members of the commission, it had not allocated a special appropriation for the study. General Humphreys informed Alexander that the survey could use no more than $5,000, drawn from the fund for "surveys for military defenses."[48]

Alexander, Mendell, and Davidson were all highly educated advocates of orderly and rational development of natural resources. All three were engineers, were influential in scientific and corporate circles in San Francisco, and were well-respected agents of the federal government. Alexander was the senior military engineer on the West Coast, Mendell supervised harbor work in San Francisco Bay and other ports, and Davidson since the 1850s had been involved in coastal surveys and other scientific activities from Panama to Alaska. Experienced, innovative, and creative problem-solvers, they were as knowledgeable as anyone about the resources and geography of the region and were natural choices for appointment to the commission.[49]

Barton Stone Alexander, a native of Kentucky, graduated from West Point in 1842. Appointed a second lieutenant in September 1843, he worked between 1843 and 1848 on construction and repair of Forts Pulaski and Jackson and on defensive works in New York Harbor. After service in the Mexican War in 1848, Alexander served in a variety of construction assignments. These included working on the technically difficult six-year project to build Minot's Ledge lighthouse and the extensive alterations to the Smithsonian Institution in Washington, D.C.

A captain when the Civil War started, Alexander served both in combat and in supervising construction of defenses. He participated in the Manassas campaign of July 1861 and was promoted to brevet major for gallantry and meritorious service. After a stint in Washington, D.C., preparing defensive works and training Engineer troops for the Army of the Potomac, he served in the Virginia Peninsula campaign from April to August 1862. He also saw action at the siege of Yorktown and at several other places.

From August 1862 through May 1864 Alexander served on various boards overseeing defensive planning and construction, and supervised building of fortifications in coastal New England and Washington, D.C. He was promoted to major on 3 March 1863. He again saw action with Major General Sheridan in the Shenandoah Valley in October 1864, including serving in the Battle of Cedar Creek. Alexander was given brevet promotions to colonel and brigadier general in March 1865 for meritorious service during the rebellion. Near the end of the Civil War he returned to construction and repairs, rebuilding Fort Washington, Maryland. In 1866 Alexander again was ordered to New England to work on fortifications and improvements to navigation on rivers in Maine. These were his last activities on the East Coast. On 7 January 1867 Alexander was named senior Engineer and charged with general supervision and inspection of Corps construction on the Pacific Coast. He also was made a member of the Pacific Board of Engineers for Fortifications. On 7 March 1867 he was promoted to lieutenant colonel.[50]

Alexander arrived in California when civil engineering experts were in short supply. His engineering skills, broad interests, and political and social connections made him an influential leader in the professional community. He soon became associated with a group of San Franciscans interested in establishing a public institution for higher learning in California. He befriended land law attorney John W. Dwinelle, the California legislator who drafted the university bill, and had close contact with the other men organizing the institution at Berkeley. Through the fall of 1867 and into 1868 he corresponded regularly with his friend John LeConte about the founding of the university. A physics professor in Georgia, LeConte (who became president of the University of California) was interested in obtaining positions at the new public institution for himself and his brother Joseph. On returning from a trip to "Russian America" in September 1868, Alexander discovered his intervention on behalf of the LeConte brothers had been successful and they had been offered chairs in the school of natural sciences.[51]

Between 1868 and 1870 Alexander investigated conditions in small harbors along the Pacific Coast. His unofficial report on Wilmington Harbor (near San Pedro and modern Long Beach, California) led to a Corps survey that suggested a solution to the siltation problems that made the harbor mouth too shallow for deep-draft shipping. Major Mendell prepared plans in 1871 for the 7,000-foot breakwater that was later constructed to protect the harbor. Alexander also served as federal representative on a state survey of Santa Cruz and Salinas Slough to assess their utility as harbors of refuge for coastal shipping.[52]

In the winter of 1870-1871 Alexander made a series of surveys for the Stockton Ship Canal Company for a proposed navigation canal running through the Sacramento-San Joaquin Delta. Alexander's suggested channel ran through the low-lying delta islands, providing a straightened channel to replace the sinuous San Joaquin River. He observed that Stockton would, with construction of the ship channel, become the head of navigation for ocean-going ships, leaving the river above that city available for irrigation. He speculated, however, that navigation on the upper San Joaquin River might be maintained for smaller steamboats if the water of Tulare

Lake was directed into the river to replenish the flows lost by diverting from the Tuolumne, Stanislaus, Merced, and upper San Joaquin rivers. He believed that the lake held sufficient water to provide not only for irrigation, but also for a navigation canal from the lake to Stockton. William Hammond Hall, a young engineer-surveyor from Stockton, carried out the actual survey of the channel line for Alexander.[53]

Later in 1871 San Francisco's Special Committee on Water Supply asked Alexander and Professor Davidson to investigate additional sources of water for the city. The two men determined that sources and reservoir sites on the San Francisco peninsula would provide enough water for the city, thus obviating the necessity of bringing in water from distant mountain sources for 50 years. Alexander also provided informal advice and prepared engineering reports on flood control methods and levee construction techniques for owners of tule lands in the Sacramento Valley and the Sacramento-San Joaquin Delta. Such projects, along with his other varied activities, introduced Alexander to many of California's leading citizens. Hall later wrote that Alexander "stood very high in the estimation of his corps, was a man of broad ideas and extensive reading and experience, and was looked to by the moneyed and landed interests of this state as the engineering authority of the Pacific Coast." In 1873 Alexander was 54 years old and at the height of his career.[54]

The second member of the Irrigation Commission from the Corps was Major George H. Mendell. Mendell graduated from West Point and joined the Topographical Engineers as a brevet second lieutenant in July 1852. For the next eight years he served in the field as an assistant topographical engineer on the survey of the Northwestern Lakes, on the staff of Major General Wool of the Department of the Pacific, and as a topographical engineer on surveys for a railroad from San Francisco to Yuma, Arizona, and for the District of Puget Sound. Mendell also took part in campaigns against Indians in the Oregon and Washington territories. Between 1856 and 1858 he was in charge of construction of military roads in the Pacific Northwest. In 1859 he was ordered back to West Point as an instructor, a position he retained until 1863.

During the Civil War Mendell saw action in the Pennsylvania, Rapidan, and Richmond campaigns, "making reconnaissances, building, guarding, and destroying bridges, constructing batteries, block-houses, rifle-trenches, etc. making and repairing roads, and carrying on Siege Operations before and about Petersburg, Va." After being promoted to major and breveted lieutenant colonel, in August 1864 he was sent to oversee construction of defenses for Baltimore. He spent the remainder of the Civil War as an instructor of "Practical Military Engineering" at the Military Academy.

Mendell went to New England at the end of the war to supervise construction of coastal defenses in Massachusetts. He reported to California in January 1867. There he was in charge of river and harbor improvements and construction of coastal fortifications. Mendell designed defensive works on Alcatraz Island, Fort Point, and Lime Point in San Francisco Bay, and at the mouth of the Columbia River. He also supervised the removal of Rincon Rock, a major hazard to navigation in San Francisco Bay; cleared wrecks from waterways; and investigated or planned improvements to other harbors on the Pacific Coast.[55]

The third federal representative on the commission was Professor George Davidson of the U.S. Coast Survey. Born in Nottingham, England, but raised in Philadelphia, Davidson studied under Professor Alexander D. Bache at Central High School in that city. Bache became head of the Coast Survey in 1844, and soon selected Davidson as his private secretary. Davidson then met A. A. Humphreys, who had been transferred to the Coast Survey from the Topographical Engineers at Bache's request in 1844 and worked as an assistant there until 1850.

Davidson remained Bache's clerk for a year, after which he volunteered for duties "more congenial to his active tastes." Life in Washington, D.C., must have chafed; in his letters Davidson referred to "Washington, D(reary) C(ity)." He performed field work during the winters in the South between 1846 and 1850; in the other seasons he acted as astronomical observer for Bache's own parties in New England. In 1850 Davidson volunteered to take charge of an astronomical and triangulation party operating on the Pacific Coast. He spent the next five years surveying harbors, selecting sites for lighthouses and other aids to navigation, and scientifically determining geographical positions of landmarks. Between 1852 and 1853 his crews determined accurate latitudes and longitudes for numerous points between San Diego and the 49th parallel. His activities in 1853 and 1854 helped sustain American claims to the Canal de Haro, between the mainland of Washington and Vancouver Island. His work in Washington Territory continued through 1857, when he returned to the East to recover his health. Davidson went back to work on the California coast in 1858, but in 1860 was forced by illness to return east to recuperate. He served in a variety of capacities during the Civil War. In 1863, during Lee's invasion of Pennsylvania, Davidson worked on fortifications near Philadelphia, an effort that continued through the spring of 1864. After the Civil War he undertook surveys in Chesapeake Bay and on the coasts of Maine, New Brunswick, Nova Scotia, Cape Breton, and Newfoundland. He then took leave to serve as chief engineer of a party surveying a proposed ship canal through the Isthmus of Panama. When this effort collapsed, Davidson rejoined the Coast Survey, ill with a tropical fever that weakened him for years thereafter.

Davidson returned to the West Coast in 1867 and performed surveys in Alaska. As a part of the work he gathered information on timber, fisheries, furs, and other industries that aided the U.S. negotiators in dealing with Russia preparatory to the Alaska purchase. He then did coastal survey work and astronomical observations in California and Alaska and, through precise use of telegraph relays, attempted to determine more accurately the correct difference in longitude between San Francisco and Cambridge, Massachusetts, and between points on the West Coast running north from San Diego to Puget Sound. Between 1868 and 1873 he worked on triangulation of the coast, studied the hydrography and topography of the coastline and ocean currents of the Pacific, and performed surveys of the Channel Islands and the coast from Panama to San Diego. During these years Davidson prepared his Directory for the Pacific Coast, containing maps, observations, information on winds and currents, and other scientific data of such practical assistance to coastal mariners that they referred to it as "Davidson's Bible." In 1873 Davidson began a systematic triangulation of

the Sierra Nevada and Coast Range to prepare for a triangulation across the continent along the 39th parallel. It was at this time that the superintendent appointed him to the federal Irrigation Commission.[56]

The three commissioners met at San Francisco on 23 April 1873, and elected Alexander president, Davidson secretary, and Mendell treasurer. The men then wrote a letter to Josiah Dwight Whitney, the California state geologist, asking him to serve. He refused.[57] Whitney had been California state geologist since April 1860, when the office was first established. His reports were important additions to scientific knowledge, but they did not seem immediately applicable to the interest of the entrepreneur. "Whitney was a scholar and a scientist," wrote historian Richard Bartlett, "and he never understood the necessity of coming down from the clouds of scientific speculation and doing some earthly lobbying."[58] However, Whitney's assistants included some of the brightest and most daring young scientists of the time, among them Clarence King and William Brewer. But appropriations for Whitney's efforts withered, and by 1868 the legislature refused to fund his payroll or expenses. For the next few years he carried on by paying for the work out of his own pocket. While he was eventually reimbursed, by 1873 his tenure as state geologist was nearly over. When Whitney declined the post on the Irrigation Commission, Albert Bierstadt, the famed painter, and William Ralston urged Humphreys to appoint Clarence King. The general advised them that neither he nor Secretary of War Belknap had the power to appoint anyone. The general stated that he had not framed the act creating the commission; if he had, he would have provided for more flexibility in appointment.[59]

Given his role in the promotion and passage of the Irrigation Commission act, it is easy to suppose that the other distinguished civilian mentioned in the measure was to be Robert M. Brereton. Shortly after passage of the act creating the commission, however, the San Francisco Chronicle, which had given moderate support to the canal company's subsidy bill, argued that no one connected with the San Joaquin & Kings River Canal and Irrigation Company should be an official part of the survey. "We have a right to expect," said the editor, "that the President will appoint no one as commissioner who is directly or indirectly interested in the company, or who might be influenced in his conclusions or recommendations by the company." More specifically, the article stated "the Commissioners should be able, without the assistance of the company's engineer, to determine how far the navigation of the San Joaquin River would be disturbed by the construction of the proposed canal." The President had appointed the commissioners to evaluate the costs and benefits of valley irrigation systems and to determine what role government should play.[60] Nevertheless, the commissioners invited Brereton to serve. He declined, citing the press of "professional engagements." At that time Brereton was at work on the canal project and perhaps he did not want to appear to taint the commissioners' recommendations. Brereton, writing to Davidson more than 40 years later, maintained that he declined the paid position in order to assure that the survey's meager budget was not consumed by salaries, thus limiting its effectiveness. Despite his unwillingness to serve in an official capacity, Brereton did travel with the commissioners on their field

examination of the southern San Joaquin Valley and made available to them technical data he had developed for the canal project. Alexander, Mendell, and Davidson decided, after Brereton and Whitney declined to serve, to begin the work of the commission "without any further addition to our numbers." They later noted that, without the expense of the two commissioners, the $5,000 allotment was sufficient to finish their tasks. Had they been compelled to pay out $4,000 in fees, the remaining funds might have been inadequate.[61]

Farmers' groups took a keen interest in the work of the commission, particularly agriculturalists in the San Joaquin Valley. The recent droughts of 1870, 1871, and 1873 had impressed upon them the need for irrigation. At a 17 May meeting of the Merced County farm club, farmers appointed a special committee to confer with the commissioners about irrigation. Local farm organizations throughout the Central Valley did likewise. In Bakersfield, the Kern County Weekly Courier announced that the Irrigation Commission was expected to visit in May and the party would consist not only of Alexander, Mendell, and Davidson but of Whitney, Brereton, and Clarence King as well. Of the latter three, only Brereton was indeed along and the press thought his knowledge of Kern County and its resources would greatly assist the commission in evaluating the country. By bringing the subject of irrigation to the attention of Congress, the Bakersfield paper hoped that the commission could induce the federal government, as a matter of public policy, "to take charge of [irrigation] in all the larger areas of the county where it may be necessary."[62]

Following the first meeting of the commissioners, Davidson wrote to the superintendent of the Coast and Geodetic Survey that the commissioners were ready to take to the field and inquired about further instructions. On 2 May he scribbled a note to Samuel Hein, Coast Survey disbursing agent. Davidson said that during the next week the commissioners would be moving north up the Central Valley and confided, "I don't hanker after the work." As the commissioners prepared to leave, Davidson became ill and Alexander postponed their departure from San Francisco for a few days. On 12 May Alexander wrote Mrs. Davidson, "I think we must leave tomorrow afternoon. The business is such that it cannot be put off on account of the sickness of one member, however important his services may be." Two days later Alexander wrote from the town of Merced that he and Mendell were leaving for Yosemite at 8:00 AM and would go up the Merced River "as much as we can." They planned to be back in town by 21 May and hoped to meet Davidson then. A telegram dated that day revealed that all three were aboard the train on their way to Tipton.[63]

At Tipton the commissioners took the stage for Bakersfield. They met Brereton there and observed the Kern River from the canyon to Kern and Buena Vista lakes. They launched a boat on Kern Lake and took soundings for two hours. Brereton had previously surveyed the whole ground, made studies of the elevation lines suitable for canals and the places best adapted for reservoirs, and calculated from State Geological Survey maps the size of the drainage basin of each of the larger streams and estimated their ordinary runoff. Next the commissioners examined the country

extending to Goshen, visited Visalia, and followed the Kings River through the foothills. They also visited Centerville and examined the headworks of the proposed irrigation canal. The party reached the San Joaquin River at Sycamore Bend and followed it to the Fresno Slough. Here they visited the lands irrigated on Henry Miller's ranch and those of others, in all about 20,000 acres. They moved on to Hill's Ferry on the San Joaquin River and the following day reached Banta Station. There they collected additional information on irrigation in the vicinity before returning by train to San Francisco. They had been in the field more than two weeks.[64] (*Figure 1*)

The Fresno Expositor, edited by J. W. Ferguson, who was running for the state legislature on the Republican ticket, reported regularly on the whereabouts of the irrigation party during May. The newspaper suggested that its readers cooperate with the commissioners "that they may be enabled to see the great necessity of recommending to the government aid for this much needed project." Ferguson did not have in mind aid to corporate land or water companies. He maintained that to protect the public interest the state should retain ownership of its waters, irrigation should be managed by local farmers and manufacturers, and no legislation should be passed that aided the "land grabbers" in obtaining control over more land or water. Up and down the valley, newspapers printed the same antisubsidy and antimonopoly message. During the summer of 1873 the San Joaquin Farmers' Club drew up a model resolution for distribution to all farm organizations in the valley, asking each to memorialize the Congress against the federal or state government granting any subsidies to the San Joaquin & Kings River Canal and Irrigation Company.[65]

In letters to friends, Davidson revealed a lack of enthusiasm for the work of the commission during its early phases. He complained on 17 May to Professor J. E. Hilgard: "This irrigation (irritation) committee breaks into my field plans and annoys me, but I suppose it is best for the survey and therefore I will do the best I can in the matter." He confided to his superintendent a few days later, "Although this irrigation commission breaks my plans badly yet I can use part of the 'contingency' of appropriation for the Pacific field work to advantage for the season's campaign and will do so unless you decide against it."[66]

On 7 June the commission met in San Francisco to discuss the first leg of their journey and to agree on a program for the next phase of field work involving the country between the Tuolumne and American rivers. The work still interfered with Davidson's personal agenda: "It retards my work but I have benefitted in health from the trip." On 16 June the commissioners headed for Modesto to follow the Tuolumne to La Grange and to visit the dam at the mouth of the canyon. They then examined the Stanislaus at Knight's Ferry and continued their survey of the Calaveras, Mokelumne, and Cosumnes rivers and their tributaries among the foothills. After reaching the American River at Folsom, the commissioners decided to reserve it for a later examination. By 21 June they were back in San Francisco. They met with Professor Whitney, who had proposed withdrawing his

telegram declining a position on the commission. Apparently, nothing developed from his offer.[67]

After this second trip, Davidson began to see the possibilities of an agricultural empire rising from the great interior desert and to have greater appreciation for the commission's work. "The magnitude and importance of the great question of irrigation for such an extensive valley grows upon us," he wrote. "With water sufficient to give from 3 to 6 more inches than the rainfall there can be irrigated not less than 5,000,000 of acres capable of yielding an average of 30 bushels of wheat per acre for some years," he added. However, Davidson was prescient about the financial, technological, and legal difficulties involved in making the valley bloom: "the surveys & engineering work will require comprehensiveness, time, skill and large amounts of money; whilst the rights to the waters will demand the decision of the highest court. This last problem will prove the most difficult to reconcile; but it does not come within our province."[68]

On 9 July, Alexander forwarded the reports for April, May, and June that Davidson, as secretary of the commission, had belatedly prepared. He admitted that the instruction to report "progress monthly" had "escaped my eye until a few days ago." He stated that the commission had examined both sides of the San Joaquin and Tulare valleys, had examined the lands already irrigated, and had followed the rivers rising in the Sierra Nevada such as the Kern, Kings, San Joaquin, Merced, Tuolumne, Stanislaus, Calaveras, and Cosumnes. The board members had planned to leave on 4 July to examine the Sacramento and its tributaries.[69]

Actually, the commissioners left San Francisco on 14 July to examine Clear Lake and Putah and Cache creeks. They returned five days later. Davidson wrote, "I have just returned from a trip with the Irrigation Commission to Clear Lake . . . to study its capabilities as a reservoir. Clear Lake is a misnomer. Out on the lake it was 120° and 101° in the shade. Now shivering in this cold, foggy city." On 29 July the commissioners started their fourth field trip, where they saw the effects of hydraulic mining debris on the western-flowing tributaries of the Sacramento River. They headed for the Yuba River, where they ascended its south fork from Smartsville to the point where the stream leaves the mountains and pours into the valley. They examined the Middle and North forks of the Yuba, the Feather River at Oroville and Cherokee, and the Sacramento to Red Bluff, Redding, and Shasta before returning to San Francisco on 5 August. Davidson reported that they had gone to the extreme head of the Sacramento Valley and beyond the limit of irrigation. It was an onerous trek carried out in the burning heat of summer but, Davidson confessed, it had been a most instructive journey.[70]

Their summer travels now over, the commission began to analyze their data, study irrigation in foreign countries, and divide up the work according to their areas of expertise. On 11 August, Alexander asked Davidson to write a report of the commission's July operations and to submit it within the next few days. He also requested Davidson to meet with him and Mendell that day to compare impressions about their field study and, if possible, to "cut out our work." Alexander later reported to Humphreys that because of the intense heat in the Central Valley the

commissioners made no further examinations in the field during September. Should the weather change, further trips would be made in October. Meanwhile, the commission was to have a large map prepared delineating a scheme for irrigation.[71]

Alexander and Davidson corresponded extensively during October. On 21 October Alexander sent Davidson a copy of William H. Bryan's 1868 report to the governor of California on an irrigation and navigation canal on the west side of the Sacramento Valley. Alexander had been reviewing the document and wanted Davidson's evaluation. Although the report contained more engineering detail than the commissioners could use, Alexander suggested that the general concept was useful. The Irrigation Commission's reclamation and irrigation plan for the west side of the valley borrowed heavily from Bryan's report. In late October Alexander informed Davidson that "if we are going to make any further examinations of the country, it is about time we were doing so." On 29 October he sent the almost-finished map and asked Davidson to critique it and suggest a title. On 7 November, Alexander and Davidson went to Josiah Whitney's office to inspect a draft of the completed map. Four days later Alexander informed Humphreys that the map, indicating a provisional system of irrigation, had been completed. The commissioners continued their studies on irrigation methods and results achieved in India and Europe.[72]

The commissioners returned to the field between 1 and 6 November to examine the valley of the upper Sacramento on the western side of the river and the headwaters of Stony Creek. They ventured forth again between 18 and 21 November to examine the lower Sacramento, Capay, and Berryessa valleys. In December the commissioners planned to visit two of the principal irrigating canals in the San Joaquin Valley and to observe the spreading of water over the land as practiced by the companies owning the canals. The commissioners expected to prepare their report upon their return but it could not be ready by the December deadline. Alexander confessed to Humphreys, "I ought to add that the magnitude of this subject, and the difficulties attending it grow upon us as the investigation progresses. We will try however to have our report ready some time during the month of January next."[73]

The November trip through the Sacramento Valley was rushed. The Weekly Colusa Sun criticized the field work of the commissioners and suggested that the "scientific" gentlemen merely took a quick glance at the countryside in a buggy for two or three days before returning to the comforts of their homes in San Francisco. How could the commissioners prepare a comprehensive irrigation scheme for the Sacramento Valley when they knew so little about the physical characteristics and environmental problems confronted by farmers in the region? "This is the great Irrigation Reclamation Commission appointed by Congress," scoffed the Sun's editor Will Green. "We have but little faith in it, and shall be agreeably disappointed if any good comes of it."[74]

Early in January 1874 Alexander notified Humphreys that the heavy and almost continuous rains in California during December had rendered roads impassable in many places. So the board had not made its proposed trip to see the distribution of water by the San Joaquin & Kings River Canal and Irrigation Company and the Fresno Canal Company in the San

Joaquin Valley. Nevertheless, the board was preparing a drawing of one company's method of distribution and planned to include it in its report.[75]

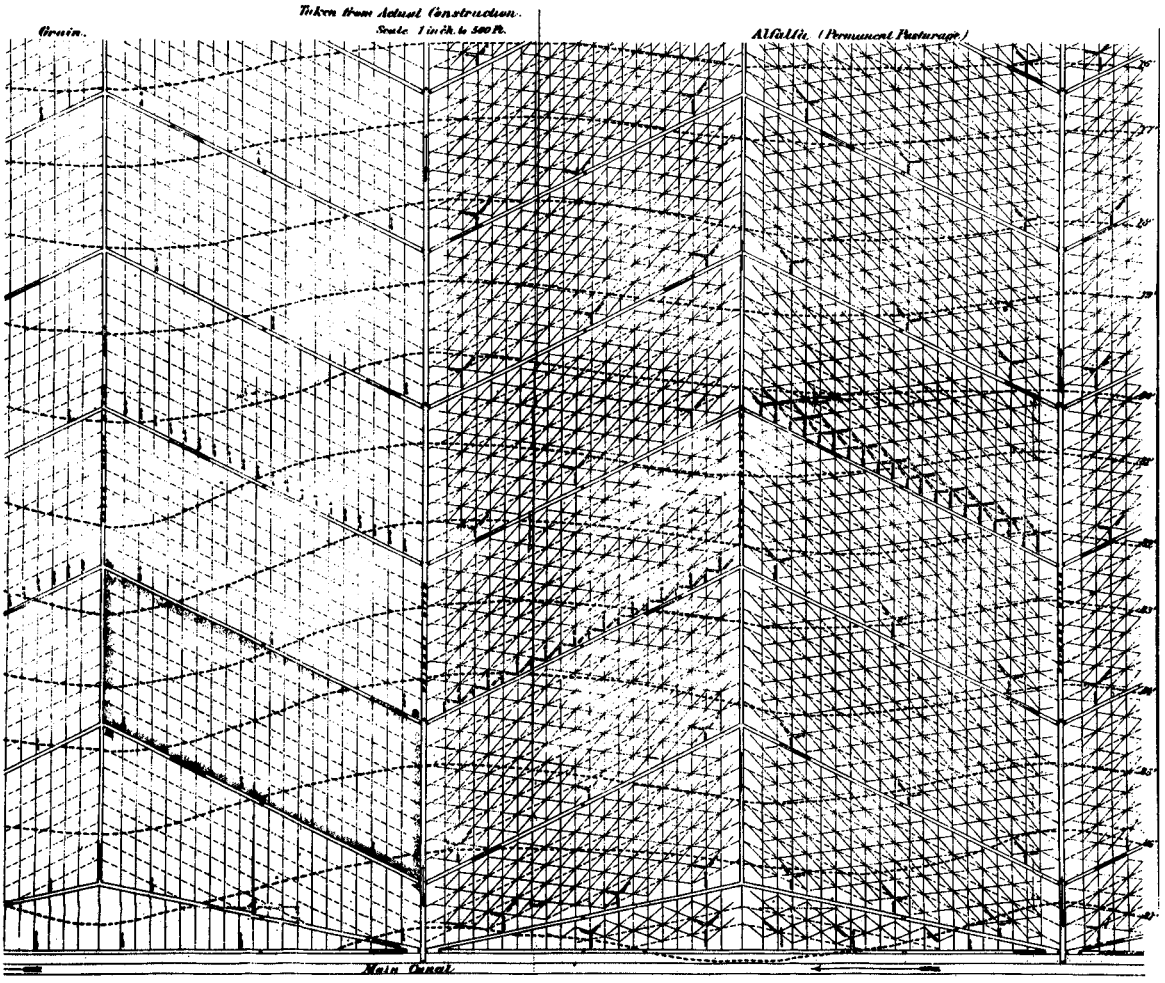
The men now concentrated on their final report, already a month late. Alexander wrote Humphreys that the commissioners had spent all of January working on the report. They had hoped to finish and forward it on 10 February but would not be able to send it for several days or perhaps a week. Alexander notified Davidson that the latter's paper on "The Necessity of Irrigation" would be incorporated as chapter II. He requested Davidson's assistance in preparing a synopsis, and stated his intention to send the completed report to the Chief of Engineers on 17 February.[76]

While the commissioners were still working on the report, the final session of the 42d Congress convened. Intense public interest in the issue of the subsidy and water monopoly continued. Congressmen John K. Luttrell and Horace F. Page introduced joint resolutions from the California legislature asking Congress to grant to the people of the state an exclusive right to use and control the unnavigable waters within the state and to "oppose the passage of all laws which are intended to grant water-rights in the State of California to private corporations or individuals." Newly elected Senator A. A. Sargent presented a second resolution from the California legislature barring subsidies to the San Joaquin & Kings River Canal and Irrigation Company, or any other water company, for the purpose of aiding them to complete canal and ditch systems on public lands.[77]

During the winter of 1873-1874 Alexander had to consider many requests from California politicians and newspapers eager for information on the commissioners' recommendations to Congress. Senator Sargent, for example, forwarded a request to the Secretary of War asking that members of the Irrigation Commission be allowed to informally share their conclusions with the editor of the Sacramento Record, primarily to benefit the water policy deliberations of the California legislature. The legislature was considering a Grange-sponsored bill, introduced by Assemblyman J. W. Veneble of Los Angeles on 21 January 1874, providing for the classification of irrigable lands, state control over water for irrigation, and creation of a state board of engineers to prepare plans for setting up local irrigation districts. Alexander and Humphreys agreed that the board might furnish orally and informally such information as may be important to the legislature or the general public, but no portion of the report was to be released prior to its submission to Congress. Alexander suggested that he retain several copies of the report to be distributed to newspapers and government officials once he was notified by telegraph that it had gone to Congress.[78]

Misunderstandings about the nature of the report continued throughout the course of the Irrigation Commission's work. As the commissioners pointed out in the text, the report was not intended to be a detailed survey upon which a definitive irrigation system could be constructed but a general reconnaissance or preliminary survey aimed at suggesting a general course of irrigation development, anticipated difficulties, and the roles of private capital and public entities in that development. For instruction the commissioners had looked to the methods of construction

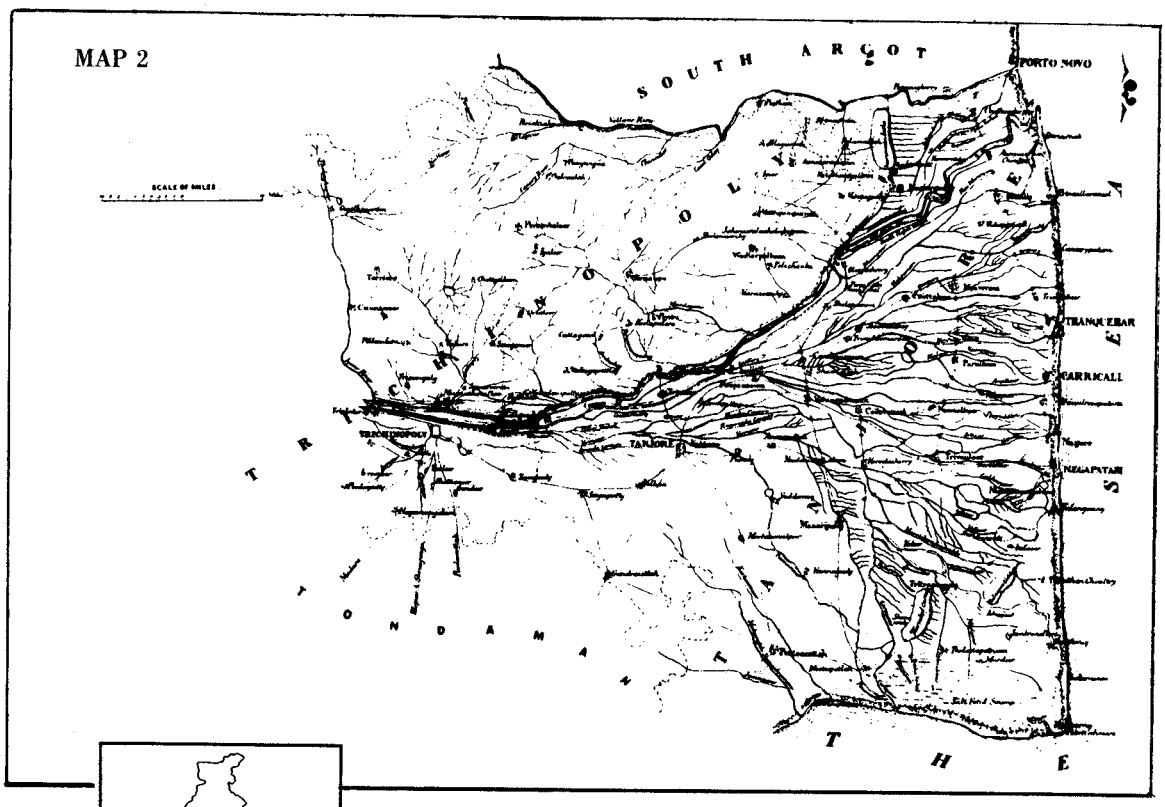
Fig. 1 *Showing the System of Irrigation as Practiced on the San Joaquin and Kings River Canal.*



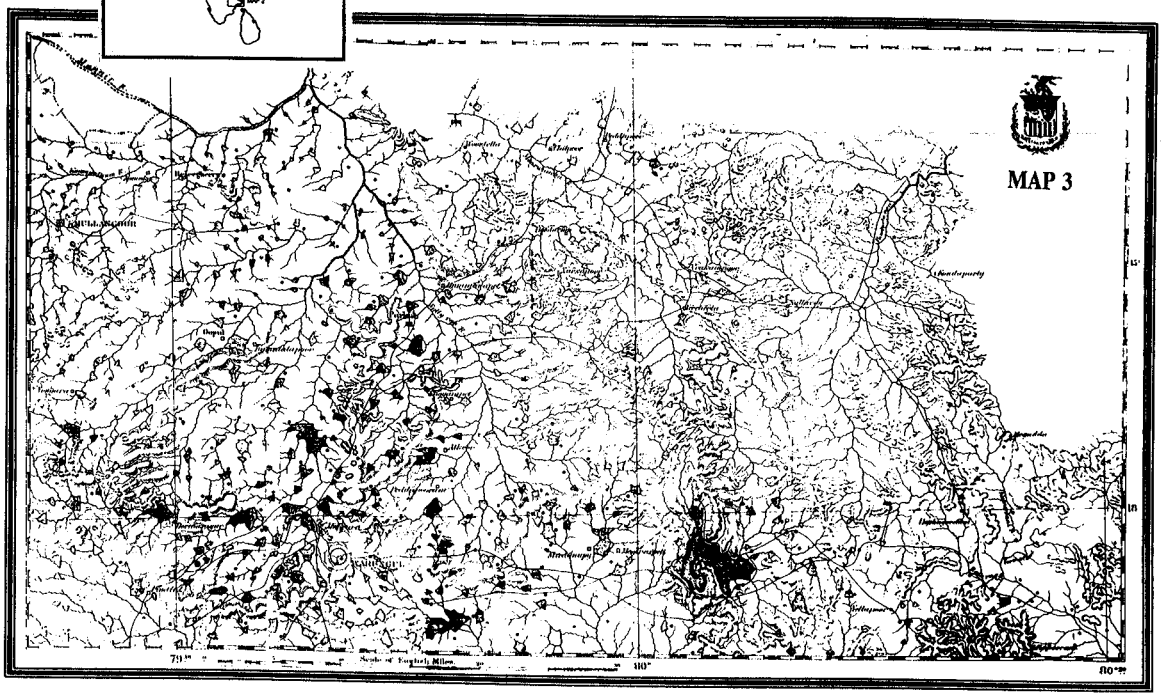
Beginning with a catch drain ditch on the left, the major vertical ditches alternate between catch drain and primary ditches. Water enters the primary ditches from the canal (bottom of diagram) and flows through the diagonal secondary ditches into the plough furrows (thin vertical lines on diagram). The furrows are diagonally cross-hatched by irrigation checks. Both checks and furrows conduct and distribute water. Unused water flows into the catch drain ditches. Checks are 50 yards apart, and furrows are 40 yards apart. All ditches are made with a 4-foot "V" scraper with the exception of furrows, which are made with a 30-inch "V" scraper.

and administration of water projects throughout the world. Irrigation was practiced for thousands of years in India and Egypt. (*Maps 2 and 3*) Cultivation using various modes of irrigation had been practiced in many other places, including the Hispanic Southwest and in areas of California. The lessons of private irrigation enterprise elsewhere in the world demonstrated to the commissioners that although irrigation systems had to be efficiently operated on a business-like basis, generally private investers had not profited.

The study emphasized the necessity for state planning and control over water resources; long-range comprehensive development of the agricul-



Map 2 depicts the delta of the Cauvery River, showing the development of the irrigation system in the districts of Tanjore and Trichinopoly, India. Map 3 shows the tank irrigation system between the Kistna and Godavery Rivers, India. Both maps were submitted as part of the original report.



tural potential of the Central Valley; and the cooperative use of state, federal, and private resources to control nature and build an agricultural empire that exceeded anything ever accomplished -- even in the ancient irrigation societies. The Irrigation Commission felt that to achieve these objectives the state and federal government had to coordinate planning and perhaps undertake the construction of the dams, levees, and canals. Because the principles of self-government were so deeply imbued in American political culture, the commissioners thought it essential that the management and distribution of water be controlled by the irrigators, perhaps formed into canal districts under regulations prescribed by the government. If the farmers themselves did not own the irrigating works, the commissioners believed that they at least had to maintain control over the distribution of water, and under no circumstances should the administration of water resources be given to private entities having no direct interest in the land. Construction and management of irrigation systems in the American West, wrote the commissioners, would require cooperation between capitalists, government, and local farmers. Individual farmers, local communities, and even large corporations had proven themselves ineffective in obtaining adequate capital, mastering technological and engineering problems, and building permanent irrigation facilities. In the modern agricultural world, farming had to be done on a business-like basis. Gone was the old agrarian vision of the individual farmer advancing civilization by confronting nature alone on the frontier. The modern ideal was that of the engineer-scientist bringing orderly economic development to the West through technological domination over nature and scientific management of natural resources.

The new technologies did not come without costs. Californians in the late 19th century experienced an environmental crisis as thousands of acres of agricultural land were robbed of their fertility. Wheat farmers had not fallowed or rotated crops; irrigators had saturated the soil, flushing the earth of nutrients and creating a favorable environment for the spread of malaria; and hydraulic miners had filled the channel beds of the Feather, Yuba, Bear, American, and Sacramento rivers with hundreds of millions of cubic yards of debris that poured over levees during floods and ruined agricultural lands. The commissioners expressed some concern over the environmental effects of water manipulation but did not demonstrate the same degree of caution as had George Perkins Marsh in Irrigation: Its Evils, the Remedies, and the Compensations. The Department of Agriculture submitted Marsh's report to Congress during the same session as the irrigation survey of the Central Valley. Marsh was an early promoter of the gospel of conservation and a pioneer in the modern viewpoint that man is a strong geographic agent. While he was alarmed about the potential for ecological disaster "in attempting a great and general revolution in our agricultural methods," he also saw beneficial applications for irrigation in the arid West where water was necessary to raise crops. Like Marsh, the Irrigation Commission advocated an activist role for federal and state government in planning and in the study of adapting "Old World" irrigation laws and institutions to American society and customs." [79]

In the decades following the Civil War, a great quantity of new and more reliable scientific information on the arid West was assembled by the Department of War and the Interior Department. Much of this work focused on reshaping public land laws west of the hundredth meridian where agriculture must depend on irrigation. The small quantity of surface water restricted the amount of land susceptible to irrigation and placed a premium on discovering methods to conserve and increase water supplies. The report of the Irrigation Commission was one of the initial attempts to state general principles on which rules and regulations might be developed to carry out the colonization of the arid region. By unanimous consent, on 11 April 1874 Congress resolved to print 5,000 copies of the Report on Irrigation of the Board of Commissioners for general distribution.[80]

IV

With the close of the commission's work, Alexander, Mendell, and Davidson returned to their regular duties. Later that year Davidson arranged for his subordinates to continue work on the triangulation project while he traveled to Japan to make astronomical observations of the transit of Venus. He asked for a leave of absence from his position with the Coast and Geodetic Survey and returned to the United States by way of China, India, Egypt, and Europe to examine the water projects and study the irrigation practices he had read about while on the commission. During his trip Davidson corresponded with Ralston, describing his investigations and boasting of his newly acquired expertise: "I have a broad and comprehensive view of the results, present and prospective, with a vast amount of information that will interest you in the development of California." On his return, Davidson wrote several articles on irrigation and related matters and submitted a report to the federal government on observations made during his trip. These experiences, coupled with his service on the commission, provided the foundation for Davidson's later activities as water consultant on several large irrigation projects.[81]

Brereton continued his efforts to arrange financing and build the San Joaquin canal project. By late 1873 he had supervised the construction or improvement of 40 miles of canal and had put 6,000 acres under irrigation. He proposed to the landowners who might be served by the project, some of the richest and largest in California, that they trade 100,000 acres of irrigable land for an equal number of shares in the company, each worth $25. However, the canal company was still struggling for survival. It had failed to convince farmers within the irrigated district to exchange water contracts for land. During the heavy winter rains that year, the ditch banks in several areas washed away, destroying the canal and adjacent lands. Some claimed the construction engineer had built the canal on too steep a grade. The cost of repairs and reimbursement to landowners for damages nearly equaled the expense of initial construction. On 9 December the trustees of the company, convinced that the government subsidy would not materialize, asked the state to condemn the canal, surveys, water rights, and company land and to have the property appraised by an impartial commission appointed by the governor or the legislature and taken over by the state at a price fixed by the commission. Governor Booth refused.[82]

Ralston suggested to Brereton late in 1874 that he seek the necessary capital to improve the canal, some $2.5 million, in London. Brereton's second trip also failed and the major landowners then backed out of the deal. Advocating big irrigation systems for the San Joaquin plains had become "like fiddling Irish jigs to Egyptian mummies, and expecting them to dance to the music," wrote a correspondent to the Pacific Rural Press. Capitalists in California and elsewhere were more interested "in mines and mining, Palace Hotels, and bankruptcy." Unwise investments and loose banking practices caused the collapse of Ralston's Bank of California and may have contributed to Ralston's death in August 1875. These events not only shook the state's economy but dashed Brereton's hopes for private financing for the irrigation project. Except for Miller and Lux, all of the major landowners who might have been served by the canal went bankrupt as the Bank of California foreclosed on their loans. With the project collapsing around him, Brereton's renewed appeals to the state to rescue the project were futile. In an open letter to the new governor, Democrat William Irwin, he urged that the state reform its laws to provide for the organization of local irrigation districts and that the state assume ownership and control of its waters. Brereton estimated a state expenditure of $7 million would be required to irrigate the project's 300,000 acres. The project could be financed by the landowners served by tying the value of water to the newly irrigated lands. In the midst of an economic depression, state officials had no interest in purchasing a poorly engineered canal with dubious water rights that could practicably irrigate only one-tenth of the land estimated by promoters of the scheme. Otherwise, the San Joaquin & Kings River Canal and Irrigation Company canal may have become the first state water project. In an ironic twist, the company's works and water rights eventually became the property of Miller and Lux, the largest of the land monopolists, whose riparian water claims held up agricultural development in the southern San Joaquin Valley for decades.[83]

Alexander, Davidson, and Mendell, through their work on the commission, enhanced their reputations as experts on the technical, engineering, and economic aspects of irrigation in California. Alexander and Mendell became principal figures in California water policy development in the 1870s and 1880s. When John Wesley Powell began his famous study of irrigation in the arid West for the U.S. Geological Survey, he asked Davidson for his papers on irrigation and consulted with him on practices abroad. In 1876, James Ben Ali Haggin began his surveys on the ill-fated West Side Canal, an ambitious plan to irrigate 340,000 acres from a ditch running from Tulare Lake, to extend north 185 miles to Antioch. The three members of the original Irrigation Commission served as consulting engineers on the project. Besides irrigation, the Corps of Engineers during the 1870s became increasingly involved in the growing controversy over reclamation of tule marshes and tidelands, and the effects of hydraulic mining debris on flood control and navigation of California rivers and bays.[84]

From the 1850s through the 1870s the democratic political culture of California staved off strong central control of natural resources management. Building irrigation systems required new forms of social organiza-

tion and a greater degree of governmental intervention along with technological skills and engineering expertise. However, the Irrigation Commission recognized that American society was not ready for the central government to control planning, construction, and management.

> In India the government does everything and the people do nothing in the management of the canal system. On the other hand, in our country we expect the people to do everything and the Government nothing. There all power and authority are in the hands of the officials, whose range extends to the merest details. This state of affairs is much lamented by intelligent observers, but in the present condition of the people any other system is impossible. We shall find in Italy and Spain that the principles of self-administration, and, in some degree, of self-government, have existed in irrigation associations for years, and in some cases for ages.
>
> Americans will doubtless find this kind of administration something congenial with their opinions, and perhaps they may discover in it the germ of their own modified system of the future.[85]

During the 1870s Californians struggled to discover this "modified system of the future." The need for more comprehensive state water policies was being felt in the state legislature. The great Marysville flood of 1875 touched off a campaign to regulate the dumping of hydraulic mining debris into the rivers. Efforts by local reclamation districts in the Sacramento Valley to hold back flood waters with levees had failed. Meanwhile, in the San Joaquin Valley, successive drought years accelerated the distress farmers and ranchers experienced during the "Terrible Seventies." Agitation by those concerned with these issues -- miners, farmers, and valley residents -- in 1876 led Republican Senator Creed Haymond of Sacramento County to propose a special state irrigation and reclamation commission including at least one engineer capable of planning irrigation and reclamation works. His bill was defeated. However, the clamor from flood-endangered and drought-ridden farmers persisted and soon led to a statewide investigation of the interrelated problems concerning irrigation, reclamation, inland navigation, and debris control.[86]

In January 1878, at the next session of the California legislature, Senator Haymond again presented a water management reform package. According to William Hammond Hall, who later became the first state engineer on the recommendation of Alexander, Haymond invited Alexander to Sacramento to give expert advice on how to deal with the debris, flood . control, and irrigation problems in the state. Alexander suggested that "money, organization, and central control" were the keys to solving the problem. He argued that the state should conduct an in-depth investigation related to the concerns of all factions. Hall thought this suggestion laid the foundation for Senator Haymond's decision to forge a coalition of interests and, in 1878, to introduce a bill to establish an investigative commission. Hydraulic mining interests, however, saw in the bill an attempt by valley farmers to attack their industry.[87]

In February 1878 the mining debris-choked Sacramento River again spilled over its levees. This event encouraged competing interests to accept a state investigation into the problems confronting valley residents. Haymond introduced a second bill creating the Office of State Engineer, the first statewide water planning agency in California. The State Engineer was given the unenviable task of studying irrigation and debris problems; mapping all irrigable lands in the state and designing plans to irrigate them; studying the effects of debris on navigation and flooding; and devising a plan to prevent injury to valley agriculture. The report was to be submitted to the legislature at its 1880 session.[88]

After the Haymond bill had passed in May 1878, Alexander was angered to find that Mendell had written the final draft. Alexander considered it "interference on the part of his subordinate officer in a movement he had fathered." While Hall thought that Mendell might not have understood Alexander's prominent role in drafting the earlier version of Haymond's water reform bill, he recalled, "General Alexander took offense, and there was bitterness between these two gentlemen who were called to act as advisors to the State Engineer."[89] It later caused "personal inharmony" between Mendell and Alexander, and many anxious moments for Hall, who had to work closely with both men. However, Alexander died in San Francisco on 15 December 1878 at age 59. Hall eulogized Alexander in his first annual report to the governor, saying that "in him the engineering profession lost one of its masters, the State Engineer was deprived of an able and most agreeable counsellor, and from the State was taken one who has seen most, thought much, and to a purpose, of the field in which this Department is called upon to act."[90]

The act creating the Office of State Engineer ordered a study of the three major problems facing the valley: irrigation, reclamation, and mining debris. With respect to irrigation the foremost task assigned to the State Engineer was determining needs, organizing water districts based on hydrographic boundaries, collecting data on stream flow and soil quality, and locating reservoir sites. From 1878 to 1888, California made the first major attempt to develop its water resources, spending more than $250,000 through the State Department of Engineering. As head of the department, Hall examined the areas of irrigation, reclamation, and debris control. He worked closely with Mendell, who replaced Alexander as the senior Corps Engineer, on the problems of flood control and navigation of inland rivers. Tutored by the Army Corps of Engineers, Hall came to his new position with a passionate belief that "the State, through a scientific board, should regulate and control all matters pertaining to the appropriation and distribution of the waters of her streams." Like his mentors, he also looked to such countries as Italy, Egypt, Spain, and India as positive examples of government involvement in irrigation. He remained, in the face of political and entrepreneurial opposition, a firm advocate of centralized governmental control over water resources in California. Thus, through the education of a young group of engineers and the rise of Hall to his prominent position as State Engineer, Alexander left a legacy on California water policy that lasted well into the 20th century.[91]

What emerged from the irrigation debates of the 1870s and 1880s, as an alternative to centralized state-controlled or corporate reclama-

tion, was a system of public control by local agencies. The Wright Act in 1887 and subsequent amendments provided a method for organizing and taxing landowners for irrigation projects, and established some minimal public control over water rights for irrigation systems in California through local irrigation districts. Forty-nine districts covering two million acres were organized in the first eight years following passage of the act. Many of them failed, beleaguered by construction cost overruns and litigation over water rights.[92] By the 1890s, the western irrigation lobby turned to Washington as drought, falling farm prices, rural depopulation, and declining land values contributed to a new farm crisis in the arid West. The irrigation crusade of the nineties culminated in the passage of the Reclamation Act of 1902.

Mendell, Davidson, and Brereton lived to see the passage of the Reclamation Act on 17 June 1902. Mendell, by this time retired from Army service and acting as a private consulting engineer, died in October 1902. At the end of his life, Brereton wrote a series of somewhat wistful letters to Davidson, complaining that "wealth has gone from me through the swindling propensity of others." On the other hand, he looked back with a sense of achievement on his own and other engineers' pioneering efforts to introduce irrigated agriculture to the Central Valley, and thought that subsequent generations of Californians would be "proud of the men of the 70ties [*sic*]." Brereton firmly believed that the 1873 survey set a new standard for investigations as the first scientific examination of irrigation. He told Davidson that Senator Stewart had written him that the survey had formed the "nucleus of the present Reclamation Service of the U.S." Professor Davidson, who served with the Coast Survey until June 1895, stayed active in scientific and educational circles until his death on 2 December 1911.[93]

The Irrigation Commission in 1873 laid the foundation for a system that the commissioners believed would control the rivers, redistribute water, and conquer the harsh environment of the Central Valley. A comprehensive irrigation plan for the Central Valley remained a dream of ambitious engineers for generations. Large-scale Reclamation Bureau projects, such as that built at Orland in the northern Sacramento Valley in 1906-1910, competed for the public imagination with grand visions such as the so-called Marshall Plan of 1919-1920. Colonel Robert Bradford Marshall, chief geographer of the Geological Survey, suggested a large storage dam at Kennett on the Sacramento River (now the site of Shasta Dam) that would partially feed a "grand canal" ringing the Central Valley. Water stored at Kennett, combined with supplies from smaller storage reservoirs on tributaries and augmented by the Klamath River, would provide water for irrigating most of the Central Valley and for navigation on the grand canal. Additional canals would supply the growing demands in Los Angeles and San Francisco.[94] Grandiose in scope, the plan rekindled public enthusiasm for a comprehensive program of irrigation during the next decade. Throughout the 1920s and into the 1930s, state and federal efforts in the valley were aimed at either adopting Marshall's plan or investigating and planning alternative projects that achieved some of his goals. California's Central Valley Project, planned in the late 1920s and adopted during the New Deal as a federal public works project, used the scientific data and built upon the general engineering concepts developed by Brereton, the Irrigation Commission, Hall, and Marshall.

Notes

1. Henry Nash Smith, "Rain Follows the Plow: The Notion for Increased Rainfall for the Great Plains," Huntington Library Quarterly 10 (1947), pp. 175-188.

2. Raymond H. Merritt, Engineering in American Society, 1850-1875 (Lexington: The University of Kentucky Press, 1969), pp. 2, 10, 110-135.

3. Charles Nordhoff, California for Health, Pleasure, and Residence. A Book for Travelers and Settlers (New York: Harper & Brothers Publishers, 1876), pp. 182-188.

4. Eighth Census of the United States, 1860 (Washington, DC, 1864), p. 662; Ninth Census of the United States, 1870 (Washington, DC, 1872), 3:820.

5. James H. Budd, "Annual Address Delivered Before the San Joaquin Agricultural Society," Transactions of the California State Agricultural Society, 1873 (Sacramento: State Printer, 1873), pp. 603-609. Hereafter cited as TCSAS. J.A. Hosmer, "Annual Address Delivered Before the San Joaquin Agricultural Society," TCSAS, 1874 (Sacramento: State Printer, 1874), pp. 616-625.

6. John Bidwell, "Annual Address Delivered Before the State Agricultural Society, September 12, 1867," TCSAS, 1866-1867 (Sacramento: State Printer, 1867), pp. 419-436.

7. TCSAS, 1866-1867, pp. 46-47; George Barstow, "Agricultural Address," TCSAS, 1868-1869, pp. 327-328; J. Ross Browne, "Reclamation and Irrigation," TCSAS, 1870, pp. 413-420.

8. Charles F. Reed, "Report to Governor Newton Booth," Biennial Report of the State Board of Agriculture for the Years 1870-1871 (Sacramento: State Printer, 1872), pp. 25-26.

9. Browne, "Reclamation and Irrigation," TCSAS, 1870, pp. 413-419; Bidwell, "Annual Address," pp. 426-429. Regarding the effect of water on history in irrigation societies, see Donald Worster, Rivers of Empire: Water, Aridity & The Economic Growth of the American West (New York: Pantheon Books, 1985), pp. 17-60. For several works that explore how proponents of efficiency and centralization tried to replace the chaos and disorganization of national life in mid-19th century America, see Robert H. Weibe, The Search for Order, 1877-1920 (New York: Hill & Wang, 1967); George M. Fredrickson, The Inner Civil War: Northern Intellectuals (Harper & Row, 1965); and Morton Keller, Affairs of State: Public Life in Late Nineteenth Century America (Cambridge: The Belknap Press of Harvard University, 1977).

10. Gerald L. Prescott, "Farm Gentry vs. the Grangers: Conflict in Rural California," California Historical Quarterly 56:4 (Winter 1977-1978), pp. 328-345.

11. Merritt, Engineering in American Society, pp. 27-62.

12. All of the comprehensive plans for irrigation of the San Joaquin Valley in the 20th century have recognized the need to transport water from the north into the water-deficient regions of the southern San Joaquin Valley. The commissioners proposed to impound water in the south and move it north.

13. Edward Hyatt, "National Broadcast on California Agricultural Programs, Under the Auspices of the State Grange, NBC Studios, San Francisco, November 10, 1939," Edward Hyatt Papers 2, Water Resources Center Archives, University of California, Berkeley.

14. Gordon R. Miller, "Shaping California Water Law, 1781-1928," Southern California Quarterly 55 (Winter 1973), pp. 9-42; A.E. Chandler, "Appropriation of Water in California," California Law Review 4 (March 1916), pp. 206-216. Michael C. Meyer, Water in the Hispanic Southwest: A Social and Legal History, 1550-1850 (Tucson: The University of Arizona Press, 1984); Robert G. Dunbar, Forging New Rights in Western Waters (Lincoln: University of Nebraska Press, 1983), pp. 1-8; Donald J. Pisani, From the Family Farm to Agribusiness: The Irrigation Crusade in California and the American West, 1850-1931 (Berkeley: University of California Press, 1984), pp. 30-53; Douglas Littlefield, "Water Rights during the California Gold Rush: Conflict over Economic Points of View," Western Historical Quarterly 14:4 (October 1983), pp. 415-434; Robert G. Dunbar, "The Adaptability of Water Law to the Aridity of the West," Journal of the West 24 (January 1985), pp. 57-65; Donald J. Pisani, "Enterprise and Equity: A Critique of Western Water Law in the Nineteenth Century," Western Historical Quarterly 18:1 (January 1987), pp. 15-37.

15. Paul W. Gates, "Public Land Disposal in California," Agricultural History 49:1 (January 1975), pp. 158-178; Warren A. Beck and Ynez D. Haase, Historical Atlas of California (Norman: University of Oklahoma Press, 1974), pp. 24-34, 67-71; Lawrence J. Jelinek, Harvest Empire: A History of California Agriculture (San Francisco: Boyd & Fraser Publishing Co., 1982), pp. 28-35;. TCSAS, 1870-71, pp. 15-16; TCSAS, 1872, p. 632. Among the major beneficiaries of the land disposal policies of the federal and state government were William S. Chapman, who brought irrigation to large tracts of valley land with his Fresno Canal and Irrigation Company; Henry Miller and Charles Lux, the cattlemen who controlled the San Francisco meat market and eventually owned both banks of the San Joaquin River from west of Modesto to near Madera, a distance of 100 miles; Billy Carr, Lloyd Tevis, and James

Ben Ali Haggin, whose San Joaquin Valley holdings became the basis of the Kern County Land Company; Isaac Friedlander, "the wheat king"; and William C. Ralston.

16. Walton Bean, California: An Interpretive History, 3d ed. (New York: McGraw-Hill Book Co., 1978), pp. 182-194.

17. Pisani, From the Family Farm, p. 105; Nordhoff, California, p. 129; Irrigation in California: The San Joaquin and Tulare Plains (Sacramento: Record Steam Book & Job Printing House, 1873), pp. 12-18. Several irrigation canals were under construction in the valley in 1872-1873. The most important were the Fresno Canal built by Isaac Friedlander near Borden Station; Lower Kings River ditch built by the Peoples Ditch Company of Tulare; Lower Kings River ditches in the vicinity of Centerville; Chapman's Canal on the San Joaquin River, diverting water 25 miles above Firebaugh's Ferry; and the Kings River & San Joaquin County Canal.

18. Pisani, From the Family Farm, pp. 106-107; John Bensley Biographical Sketch, MS, John Bensley Papers, Bancroft Library, University of California, Berkeley; Marysville Appeal, 14 June 1873.

19. David Lavender, Nothing Seemed Impossible: William C. Ralston and Early San Francisco (Palo Alto, CA: American West Publishing Co., 1975), pp. 353-355; Commercial Herald and Market Review, 12 January 1872, in Cecil G. Tilton, William Chapman Ralston: Courageous Builder (Boston: The Christopher Publishing Co., 1935), pp. 161-164.

20. Michael Edwardes, British India, 1772-1947: A Survey of the Nature and Effects of Alien Rule (New York: Tapinger Publishing Co., 1967), pp. 149-155, 216-228; Robert Burton Buckley, Irrigation Works in India and Egypt (New York: Spon & Chamberlain, 1893), pp. 269-294; Robert Maitland Brereton, Reminiscences of an Old English Civil Engineer, 1858-1908 (Portland, OR: The Irwin-Hodson Co., 1908), pp. 7-17.

21. Brereton, Reminiscences of a Civil Engineer, pp. 18, 23-24. In a letter written to George Davidson forty years later Brereton claimed he had come to the United States on "a mission from the Government of India" to inspect railroad construction methods in the United States and had let Ralston convince him to abandon this work and enter into the irrigation scheme. Although he remained proud of his efforts to bring irrigation to the San Joaquin Valley, later in life Brereton was embittered by his association with the enterprise as it had deprived him of prestigious career opportunities as chief engineer of railways in India, Japan and Australia. Brereton to Davidson, 14 and 19 Apr. 1911, Davidson MS, Bancroft Library.

22. Brereton, "Report No. 1 to Messrs. Friedlander, Ralston, Chapman, and Others," 19 Aug. 1871, in Robert M. Brereton, Reminiscences of an Irrigation Enterprise in California (Portland, OR: The Irwin-Hodson Co., 1903), pp. 54-59; Stockton Independent, 29 April and 17 May 1871.

23. Brereton, "Report No. 2 to Messrs. Friedlander, Ralston, Chapman, and Others," 6 Oct. 1871, in Brereton, Reminiscences of an Irrigation Enterprise, pp. 59-72.

24. Sacramento Union, 2 November 1871; Stockton Independent, 15 August and 18 October 1871.

25. Brereton, Reminiscences of a Civil Engineer, pp. 28-30; J. Ross Browne to W.C. Ralston, 11 Nov. 1871, William C. Ralston Collection, Bancroft Library. Hereafter cited as Ralston Collection.

26. Sacramento Union, 30 January 1872; Appendix to the Journals of the Senate and Assembly of the Legislature of the State of California, 19th sess., vol. III.

27. Winfield J. Davis, History of Political Conventions in California, 1849-1892 (Sacramento: Publications of the California State Library, 1893), pp. 303-304; W.C. Ralston to Newton Booth, 18 Jan. 1872, and Ralston to Booth, 18 June 1872, in Brereton, Reminiscences of a Civil Engineer, pp. 74-75, 86; Biographical Directory of the American Congress, 1774-1971, Sen. Doc. 92-8, 92d Cong., 1st sess. (Washington, DC: Government Printing Office, 1971), p. 612; Royce D. Delmathier et al., The Rumble of California Politics, 1848-1970 (New York: John Wiley & Sons, Inc., 1970), pp. 40-69.

28. Brereton, Reminiscences of a Civil Engineer, p. 30; Brereton, Reminiscences of an Irrigation Enterprise, pp. 8, 18-20; Charles Stuart to William Ralston, 13 Apr. 1872, 27 July 1872, and 15 Aug. 1872; Brereton to Ralston, 17 July 1872, Ralston Collection, Bancroft Library.

29. Louise Hall Tharp, Three Saints and a Sinner, Julia Ward Howe, Louisa, Annie and Sam Ward (Boston: Little, Brown & Co., 1956).

30. Brereton, Reminiscences of a Civil Engineer, p. 27.

31. A good general discussion of the antimonopoly attitudes in California is contained in David B. Griffiths, "Anti-Monopoly Movements in California, 1873-1898," Southern California Quarterly 52 (Spring 1970), pp. 93-121.

32. Brereton, Reminiscences of a Civil Engineer, p. 27; San Francisco Chronicle, 21 February 1873.

33. Congressional Globe, 41st Cong., 1st sess., 22 March 1869, p. 190; Stockton Independent, 1 and 22 February 1873, 22 May 1873, 6 and 9 June 1873, and 2 July 1873; Sacramento Union, 1, 2, 7, and 19 July 1873 and 18 October 1873.

34. By the middle of February most of the newspapers began referring to this bill as "the Stewart Bill." William M. Stewart, Senator from Nevada, introduced the bill providing for the appointment of a Board of Irrigation Commissioners. He was also a major supporter of the subsidy bill that many newspapers initially tended to view as a companion bill to the canal subsidy legislation.

35. Sacramento Bee, 14 February 1873; Tulare Times, 15 February 1873.

36. Sacramento Union, 15 February 1873; Stanislaus County News, 21 February 1973.

37. San Francisco Chronicle, 21 February 1873.

38. Cole to Ralston, 2 Feb. 1873, Ralston Collection, Bancroft Library.

39. Gorham to Ralston, 16 Feb. 1873, Ralston Collection, Bancroft Library.

40. San Francisco Chronicle, 29 February 1873; Sacramento Union, 28 February 1873. The last provision was particularly significant because at that time the Central Pacific Railroad was claiming in the courts that the land grants it received from the federal government were quasi-federal property and therefore exempt from local taxation until sold. San Francisco Chronicle, 22 February 1873.

41. Congressional Globe, 42d Cong., 3d sess., 27 February 1873, p. 1846.

42. On the organization of farm clubs and Grange chapters and their opposition to the bill, see the weekly issues of the Pacific Rural Press from March through December 1873; Tulare Times, 22 February 1873.

43. Congressional Globe, 42d Cong., 3d sess., 13 February 1873; Sacramento Union, 15 February 1873; Russell R. Elliott, Servant of Power: A Political Biography of Senator William M. Stewart (Reno: University of Nevada Press, 1983). When he left the Senate in 1875, Stewart served as attorney for a number of large landowners in California and represented Haggin and Tevis in their San Joaquin Valley water battles in the 1870s and 1880s. When he returned to the Senate in 1887, he became a champion of irrigation in the arid West and was in part responsible for passage of the act authorizing a federal irrigation survey of western territories and states in 1888-1889. He was chairman of the Senate Subcommittee on Irrigation and Reclamation of Arid Lands when

that special body was added to the Public Lands Committee in 1889. Stewart invited Brereton to work on the irrigation survey but Brereton declined. See Brereton, Reminiscences of an Irrigation Enterprise, pp. 20-21.

44. Sacramento Bee, 25 February 1873; Sacramento Union, 6 March 1873; Marysville Appeal, 16 February 1873. Houghton's bill was numbered H.R. 3966.

45. Congressional Globe, 42d Cong., 3d sess., 17 January 1873, p. 660; 10 February 1873, p. 1232; 13 February 1873, p. 1297; 14 February 1873, p. 1313; 17 February 1873, p. 1422; 27 February 1873, p. 1846; 28 February 1873, pp. 1916 and 1930; 3 March 1873, pp. 2135, 2200, and 2202.

46. Message from the President of the United States Transmitting the Report of the Commissioners on the Irrigation of the San Joaquin, Tulare, and Sacramento Valleys, in the State of California, H. Exec. Doc. 290, 43d Cong., 1st sess., 24 March 1874.

47. Brereton, Reminiscences of a Civil Engineer, p. 26.

48. Special Orders No. 75, 9 Apr. 1873; Brig. Gen. A.A. Humphreys to Lt. Col. B.S. Alexander, 12 Apr. 1873; Benjamin Peirce to George Davidson, 25 Apr. 1873. All cited in Message from the President of the United States.

49. For example, see the correspondence between Mendell and Davidson in Davidson Papers, Bancroft Library, 1870-1873.

50. "Barton S. Alexander," Office of History Biographical Files.

51. LeConte had been worried that his service in the Confederate Army during the Civil War would be held against him. Alexander assured him that it would not. Alexander himself was strongly opposed to Radical Reconstruction, and commented on the possible negative effects of "the event of negro supremacy" in LeConte's home state of South Carolina. B.S. Alexander to John LeConte, 25 Oct. 1867, 19 June 1868, and 24 Sept. 1868, Box 1, folder: Alexander, Barton Stone, LeConte Family Papers, Bancroft Library. LeConte Hall on the Berkeley campus is named in honor of the LeConte brothers, who both served long terms on the faculty.

52. Anthony F. Turhollow, A History of the Los Angeles District, U.S. Army Corps of Engineers, 1898-1965 (Los Angeles: U.S. Army Engineer District, 1975), pp. 24-28; Lt. Col. B.S. Alexander and C.W. Lightner, Report of the Commissioners Appointed to Examine the Harbor of Santa Cruz and Salinas Slough in the Bay of Monterey, 26 February 1870, pamphlets on engineering, Bancroft Library.

53. Lt. Col. Barton S. Alexander, Reports of B.S. Alexander, Lieut. Col. Engineers of the Preliminary Surveys, Cost of Construction, &c. of the Stockton Ship Channel, Stockton California (Stockton: Independent Press, October 1874); William Hammond Hall, State Engineer, to the Governor of California, "Drainage and Debris Work of 1878-1881, First Letter, The Origin and Conditions of the Investigation," 8, file F3748: 20-42, Records of the State Engineer, California State Archives, Sacramento; see also Nicholas P. Hardeman, The Harbor of the Heartlands: A History of the Inland Seaport of Stockton, California, From the Gold Rush to 1985 (Stockton: Holt-Atherton Center for Western Studies, 1986), pp. 33-34. Hardeman says Alexander was "later known as the father of the Central Valley Project." Stockton is a major deepwater port in California because of the maintenance of a shipping channel similar to that proposed by Alexander.

54. Report of the Special Committee of the Board of Supervisors, Together With Recommendations of Gen. B.S. Alexander, U.S.A., and Prof. George Davidson U.S.C.S., on the Water Supplies for the City of San Francisco (San Francisco: A.L. Bancroft & Co., 1872); "Report of General Barton Stone Alexander on the Reclamation of the Rancho Pescadero, San Joaquin County," 1877, Bancroft Library Pamphlets; William Hammond Hall, State Engineer, to the Governor of California, "Drainage and Debris Work of 1878-1881, First Letter, The Origin and Conditions of the Investigation," 7, file F3748: 20-42, Records of the State Engineer, California State Archives, Sacramento.

55. "George H. Mendell," Office of History Biographical Files. Mendell's San Francisco office letter press books are housed at the Bancroft Library. During the time of the irrigation survey, Mendell was pressed for information regarding an action during the war where his men destroyed a barn to obtain timber for a temporary bridge across a stream. (The farmer wanted compensation for his wrecked building.) Mendell recalled that circumstances -- he and his men were under Confederate guns at the time -- had dictated that demolition and construction be done quickly. See Letterbook, vol. 1.

56. Oscar Lewis, George Davidson: Pioneer West Coast Scientist (Berkeley: University of California Press, 1954), pp. 1-5, 8-9, 38-39, 51-52; George Davidson to Benjamin Peirce, see various 1873 Letterbooks, vol. 25, Davidson Papers, Bancroft Library; Alonzo Phelps, Contemporary Biography of California's Representative Men With Contributions From Distinguished Scholars and Scientists (San Francisco: A.L. Bancroft & Co., 1881), pp. 97-101. Lewis's biography provides a comprehensive description of Davidson's career, interests, and accomplishments.

57. Message from the President of the United States, p. 5.

58. Richard A. Bartlett, Great Surveys of the American West (Norman: University of Oklahoma Press, 1962), pp. 135-136.

59. The history of Whitney's experience in California is detailed in William H. Goetzmann, Exploration and Empire: The Explorer and the Scientist in the Winning of the American West (New York: Random House, 1972), pp. 355-389; Albert Bierstadt and William C. Ralston to General A.A. Humphreys, 13 and 20 May 1873; Humphreys to Bierstadt and Ralston, 2 June 1873, entry 52, 929 GR 1874, enc. 1027, Record Group 77, National Archives.

60. San Francisco Chronicle, 17 March 1873.

61. Robert Brereton to George Davidson, 9 Sept. 1911, Davidson Papers, Bancroft Library; Message from the President of the United States, pp. 5-6.

62. Pacific Rural Press, 7 June 1873, 5:356; quote from Kern County Weekly Courier, 17 May 1873. No evidence confirming the presence of Whitney or King with the commissioners has been found. Stanislaus County News, 30 May 1873.

63. Davidson to Samuel Hein, 2 May 1873, Letterbooks. Alexander to Davidson, 9, 14, and 21 May 1873; Alexander to Ellinor Davidson, 12 May 1873. All in Davidson Papers, Bancroft Library.

64. Kern County Weekly Courier, 17 May 1873; Davidson to Alexander, Monthly Report, 31 May 1873, entry 52, 927 GR 1874, RG 77, National Archives.

65. Fresno Expositor, 21 May 1873; Pacific Rural Press, 7 June and 12 July 1873; The Weekly Appeal (Marysville), 14 June 1873.

66. Davidson to J.E. Hilgard, 17 May 1873. Davidson to Superintendent of the Coast and Geodetic Survey, 21 May 1873. Both Letterbooks, Davidson Papers, Bancroft Library.

67. Davidson to Alexander, Monthly Report, 30 June 1873, entry 52, 927 GR 1874, RG 77, National Archives; quote from Davidson to Samuel Hein, 9 June 1873, Davidson Papers, Bancroft Library.

68. Davidson to Superintendent of the Coast and Geodetic Survey, 23 June 1873, Letterbooks, Davidson Papers, Bancroft Library.

69. Alexander to Humphreys, Monthly Report, 9 July 1873, entry 52, 927 GR 1874, RG 77, National Archives.

70. Alexander to Humphreys, Monthly Report, 20 Aug. and 10 Sept. 1873, entry 52, 927 GR 1874, RG 77, National Archives; quote from Davidson to Superintendent of the Coast and Geodetic Survey, 24 July 1873; Davidson to Superintendent of the Coast and Geodetic Survey, 6 Aug. 1873. Both in Letterbooks, Davidson Papers, Bancroft Library.

71. Alexander to Humphreys, 20 Aug. 1873, entry 52, 927 GR 1874, RG 77, National Archives; quote from Alexander to Davidson, 11 Aug. 1873, Davidson Papers, Bancroft Library; Alexander to Humphreys, Monthly Report, 7 Oct. 1873, entry 52, 927 GR 1874, RG 77, National Archives.

72. Alexander to Davidson, 21 Oct. 1873, Davidson Papers, Bancroft Library; William H. Bryan, Report of the Engineer of the Sacramento Valley Irrigation and Navigation Canal (Sacramento: State Printer, 1868). Quote from Alexander to Davidson, 28 Oct. 1873; Alexander to Davidson, 29 Oct. 1873; Alexander to Humphreys, 7 Nov. 1873. All in Davidson Papers, Bancroft Library. Alexander to Humphreys, 11 Nov. 1873, entry 52, 927 GR 1874, RG 77, National Archives.

73. Alexander to Humphreys, 4 Dec. 1873, entry 52, 927 GR 1874, RG 77, National Archives.

74. Weekly Colusa Sun, 8 November 1873.

75. Alexander to Humphreys, 5 Jan. 1874, entry 52, 927 GR 1874, RG 77, National Archives.

76. Alexander to Humphreys, 10 Feb. 1874, entry 52, 927 GR 1874, RG 77, National Archives; Alexander to Davidson, 16 Feb. 1874, Davidson Papers, Bancroft Library; Alexander to Humphreys, 5 Mar. 1874, entry 52, 927 GR 1874, RG 77, National Archives.

77. Congressional Record, 43d Cong., 1st sess., 5 January 1874, p. 387; 6 January 1874, p. 388; 6 February 1874, p. 1255.

78. Assembly Bill 172, 21 January 1874, Assembly Bills, 1873-74, California State Archives. The Veneble bill passed in the Granger-controlled assembly but was voted down in the Senate. Pacific Rural Press, 15 November 1873, 6:308; and 28 March 1874, 7:201; Alexander to Humphreys, undated correspondence, entry 52, 927 GR 1874, RG 77, National Archives.

79. George Perkins Marsh, Irrigation: Its Evils, the Remedies, and the Compensations, Sen. Misc. Doc. 55, 43d Cong., 1st sess., 6 February 1874. John Wesley Powell, a scientist and explorer who spent much of his time after 1867 observing and studying the natural resources of the West, also submitted a report to Congress in April 1874. He advocated "cooperative organizations" of great capitalists, the states, and the national government to develop projects for irrigating extensive acreages on the main watercourses of the American West. H. Ex. Doc. 612, 43d Cong., 1st sess., 21 Apr. 1874.

80. Congressional Record, 43d Cong., 1st sess., 6 February 1874, p. 3009.

81. Phelps, Contemporary Biography, p. 101; Davidson to Ralston, 15 May 1875, Ralston Papers, Bancroft Library; George Davidson, Report upon

the Methods Employed in Irrigating Land in India, Egypt, Italy, and Other Countries, Sen. Ex. Doc. 94, 44th Cong., 1st sess., 1875; Davidson, "Lectures on Irrigation Before the Legislature of California," 15-16 Jan. 1878, Davidson Papers, Bancroft Library.

82. Brereton, Reminiscences of a Civil Engineer, pp. 28-30; Pacific Rural Press, 22 November 1873 and 4 April 1874, 7:10; Sacramento Union, 20 February 1874.

83. Pacific Rural Press, 30 October 1875; Brereton, Reminiscences of a Civil Engineer, pp. 28-30; Bean, California: An Interpretive History, pp. 192-193; Brereton, Reminiscences of an Irrigation Enterprise, pp. 24-35. Brereton sent his letter to Governor Irwin on 16 November 1875; it was published by the San Francisco Chronicle on 21 November 1875.

84. John Wesley Powell to Davidson, 25 May 1877; James B. Haggin to Davidson, 6 Nov. 1877; Alexander to Davidson, 5 Dec. 1877 and 10 Mar. 1878, Davidson Papers, Bancroft Library. Haggin published their short report, which drew heavily on the 1873 irrigation survey, as a part of his larger document, The Desert Lands of Kern County, California (San Francisco: C.H. Street, 1877); William Hammond Hall, Report of the State Engineer to the Legislature of the State of California, Part I (Sacramento: State Office of Printing, 1881).

85. Message from the President of the United States, pp. 48-49.

86. Robert L. Kelley, Gold vs. Grain: The Hydraulic Mining Controversy in California's Sacramento Valley: A Chapter in the Decline of the Concept of Laissez Faire (Glendale, CA: The Arthur H. Clark Co., 1959), pp. 57-131; Thomas E. Malone, "The California Irrigation Crisis of 1886: Origins of the Wright Act" (Ph.D. diss., Stanford University, 1965), pp. 64-65; Pisani, From the Family Farm, p. 162.

87. William Hammond Hall, State Engineer, to the Governor of California, "Drainage and Debris Work of 1878-1881, First Letter, The Origin and Conditions of the Investigation," pp. 5-10, Records of the State Engineer, file F3748: 20-42, California State Archives, Sacramento; Pisani, From the Family Farm, p. 167.

88. "An Act to Provide a System of Irrigation, Promote Rapid Drainage, and Improve the Navigation of the Sacramento and San Joaquin Rivers," 28 March 1878, 22 Cal. Stats., pp. 634-636; Kelley, Gold vs. Grain, pp. 65-84.

89. William Hammond Hall, State Engineer, to the Governor of California, "Drainage and Debris Work of 1878-1881, First Letter, The Origin and Conditions of the Investigation," pp. 5-10, Records of the State Engineer, file F3748: 20-42, California State Archives, Sacramento.

90. Alta California, 16 December 1878; William Hammond Hall, Report of the State Engineer, p. 26.

91. Charles P. Korr, "William Hammond Hall: The Failure of Attempts at State Water Planning in California, 1878-1888," Southern California Quarterly 45:4 (December 1963), pp. 305-321; quote from William Hammond Hall, Report to the Honorable Board of Commissioners of the West Side Irrigation District, 18 December 1877, Appendix to the Journals of the Senate and Assembly of the State of California, 22d sess., 1877-1878, vol. 4 (Sacramento: State Printer, 1878); Lt. Col. George H. Mendell, Report on a Project to Protect the Navigable Waters of California from the Effects of Hydraulic Mining, H. Ex. Doc. 98, 47th Cong., 1st sess. (Washington, DC: Government Printing Office, 1882).

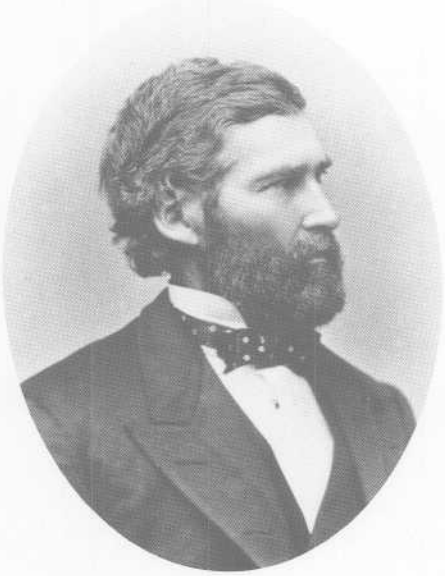
92. Department of Public Works, Division of Water Resources, Financial and General Data Pertaining to Irrigation, Reclamation and Other Public Districts in California, Bulletin No. 37 (Sacramento: California State Printing Office, 1931), pp. 25-106.

93. "George H. Mendell," Office of History Biographical Files; San Francisco Chronicle, 20 October 1902; San Francisco Call, 21 October 1902; Robert Brereton to George Davidson, 16 Apr. 1899, 3 Sept. 1910, 14 Apr. 1911, and 29 Sept. 1911, Davidson Papers, Bancroft Library; Lewis, George Davidson, pp. 121-128.

94. Pisani, From the Family Farm, pp. 396-403.

Lieutenant Colonel Barton S. Alexander

Major George H. Mendell



Professor George Davidson