What is this strange quality in humans that makes them court disaster? They build their homes on flood-plains and riverbanks, cliff edges, slipping hillsides, brush-choked canyons and on the slopes of volcanoes. . . . All over this planet we (defy) the eternal forces of nature. Then we try to coerce those forces into doing our bidding.

Arthur Hopkins, San Francisco Chronicle. Quoted in Rivers of Fear, p. 34.

In Alta California, a quiet and remote province in a far northwestern corner of the Spanish Empire, in the year 1808, a young officer of the Crown, Ensign Gabriel Moraga, led a small exploring party through the maze of bays, islands, and channels which lie easterly of San Francisco Bay, working his way into what was clearly a great delta. He was searching for the source of a heavy flow of water which poured in among the delta islands from the north. In time he came to it, a deep, clear, strongly moving river, many hundreds of feet across, which in honor of his church’s holiest sacrament, the eucharist, he named the Sacramento.

Ascending the wide stream, he entered the Sacramento Valley, a warm and abundant natural environment rich in wild game. Thousands of antelope, tule elk, and deer grazed the Valley floor in drifting bands; grizzly bears hunted the thickets near the rivers; and the Valley’s many small and larger watercourses were full of fish. The Indian peoples of the Valley clustered near the watercourses, living in villages made of tule-reed hutmets. Walled off from each other by language barriers in their separate enclaves of flatland and rough hill country, they called themselves by such names as the Co’l’us and the Maidu and the Yana.

A contemporary sketch of the city of Sacramento during the high water of the winter of 1849–1850. On January 10, 1850 the new American town was under water for a mile back from the embarcadero. Shortly, the town was launching its first of many levee construction projects.

Courtesy: California State Library.
THE SACRAMENTO VALLEY

The Indians conducted their lives in synchrony with the Valley’s resources and rhythms, living in relative abundance in their golden valley by gathering grass seeds and acorns, occasionally by killing large game animals or netting wild geese—great sport for the young men—and often by catching fish with nets of wild hemp cast into the streams. They did little more to violate the Valley’s nature than to wade out into the watercourses each spring, and drive poles vertically into stream beds to form crude dams as, yearly, the salmon in a swelling tide returned from the sea to swarm upstream to their spawning grounds; they even formed such dams across the Sacramento itself where it was sufficiently shallow, and thereby created salmon-catching ponds. Through much of the year, drying salmon strung up by the Indians’ tule-reed houses gave their villages a reddish aspect.

Indeed, as Theodora Kroeber’s tale of Ishi tells us, even among his remote people, the Yahi, who dwelled far inland by one of the smaller streams of the Mt. Lassen foothills, the annual advent of the salmon crowding into upland waters was for them a wondrous time of the renewal of nature’s abundance, of sport and carnival and feasting. And it was no less for the Co’lus of the Valley floor or the Yurok peoples living along the large rivers of the north California coast.¹

The Valley itself, which forms the northern third of California’s 400-mile-long Central Valley, is a broad flat amphitheater lying open to the south. Its floor, most of which is essentially a floodplain, rises so slowly and imperceptibly from the bay that eighty miles in a direct line north of the Sacramento’s mouth, it lies but sixty feet above sea level. Running a hundred and fifty miles north to south, the Valley attains a width of roughly forty miles through most of this distance. (The Sacramento River is actually 370 miles long from its headwaters in the Trinity Mountains to the delta, but local usage restricts the term “Sacramento Valley” to the flatlands downstream from Red Bluff, which is 247 river-miles, including bends and switchbacks, from the river’s mouth.) About midway in its length, a compact group of small volcanic mountains, the Sutter Buttes, rears up steeply from the Valley floor, offering the only visual break in the level plains. In Moraga’s time, birds of all descriptions swept overhead in flocks that

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could darken the sky, making the air clamorous with the sound of their wings and their loud cries.

The flatlands of the Valley were studded with oaks—high, stately trees with broad spreading crowns. The deep flowing Sacramento dominated the scene, its banks lined by a tangled riverine growth of tall oaks, sycamore, cottonwood, willow, and ash, about a mile in width. Men traveling horseback across the Valley floor in the late 1840s rode through open seas of wild oats and other grasses standing six feet high, stretching as far as the eye could see, and so thickly grown that their horses could only make their way with difficulty.

In normal flow the Sacramento is a big river, carrying about 5,000 cubic feet per second, but in flood times it can on occasion swell gigantically to such immense flows as 600,000 cubic feet per second. Indeed, the river’s channel could never contain within its natural banks the huge flows of water that almost annually poured out of the canyons of the northern Sierra Nevada. Signs of yearly flooding were everywhere apparent to Ensign Gabriel Moraga, reaching out, he estimated, to cover a band of territory perhaps five miles across on the eastern side and three miles on the west.

In effect, each watercourse on the flat Sacramento Valley floor, from small stream to great river, flowed on an elevated platform, built up by the silt the streams deposited in their own beds. As floodwaters periodically rose to overtop the stream banks and spread out over the Valley floor, natural levees were also built up, for as the overflowing waters lost velocity they dropped their remaining burden of silt most heavily on the land immediately bordering the rivers. From these more elevated locations paralleling the watercourses, floodwaters flowed down to pond in wide shallow basins lying between the streams, the broad expanse of these flood-created lakes often leaving nothing dry but the natural levees bordering the rivers and the higher lands next to them. Together, the ponds in the basins annually created a vast inland sea a hundred miles long occupying the centerline of the Sacramento Valley which slowly drained back into the river channels and down through the delta during the spring months. In their lowest elevations, where the water ponded longest, these ba-
sins contained immense swamps of tules (that is, large bulrushes), standing ten to fifteen feet high. The Indians built not only their homes but their boats and sleeping mats of these tall, woody reeds.  

For thirty years after Moraga's explorations, the Valley saw little further intrusion from the European settlements along the coast, where the Spaniards had planted missions and royal presidios since their arrival in the 1760s. The Latin American wars of independence began within two years of Moraga's journey, and they continued into the 1820s, after which California was placed within the newly created Republic of Mexico. By the 1830s the authorities in Mexico City had decided to begin a rapid development of their country's frontier regions, such as the distant state of Alta California, by the granting of rancho lands to enterprisers willing to stock them with cattle and raise crops.

In 1829 a Swiss adventurer, John Sutter, arrived on the California scene to secure a large grant from the authorities in Monterey, Alta California's capital. He was the first of the grantees to locate his rancho in the Sacramento Valley, placing it along a Sacramento tributary that in later years would be called the American River. Knowing of the Sacramento's habit of annual flooding, he placed his New Helvetia fort and settlement some two miles back from that stream and immediately launched his many ambitious undertakings.

The British and American governments were much interested in California. Periodic local revolts against Mexico City authorities led to increasing talk that the state might become a British protectorate or part of the American Union. Therefore, naval officers from these two nations were sent to explore the region. On his entry into the Sacramento Valley, Sir Edward Belcher observed flood marks on the trees which demonstrated, to his amazement, that the great river rose at least ten feet in high water, producing floods that ran not simply the few miles out onto the plains as Moraga had estimated, but instead created "one immense sea, leaving only scattered eminences which art or nature have produced, as so many islets or spots of refuge."

Lieutenant Charles Wilkes of the United States Navy arrived in 1841 to learn from the Indians that the whole country, for a hundred
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miles up the Valley, was almost annually under water. He was even able to discover the general outlines of the river’s performance in floodtimes, observing that, as is indeed the case, the first major outflows over the Sacramento’s banks occur as it passes by the Sutter Buttes, “and [they submerge] the whole of the Sacramento Valley as far down as the San Joachim [sic].”

Wilkes also reported that the Sacramento would be an excellent stream for navigation by large vessels. It was so flat in its gradient that in the Sacramento’s lower 247 river-miles from Red Bluff to the delta, it drops an average of only a foot a mile. The daily tides, pouring in the Golden Gate of San Francisco Bay, reached inland to flow far up the Sacramento, producing rises of two to three feet some sixty river-miles upstream at the present site of the city of Sacramento.

The river, therefore, could carry to that point vessels drawing up to twelve feet of water, even when it was at a low water stage. “The banks of the river,” Wilkes went on to remark, “are bordered with marshes, which extend for miles back . . . [forming] the proper Tula [sic] district of which so much has been said.” Eight years later, after the American acquisition of California in the Mexican War, another American naval officer making a systematic survey said that the tule swamp ran as far northward as the Buttes, observing that it was “impassable for six months out of the year.”

In 1848 John Sutter resolved to make a large-scale industrial use of water power, a largely unprecedented undertaking in California. He caused a sawmill to be constructed on the upper reaches of the American River, where it could get power from the swiftly flowing stream. When his foreman found gold in the mill’s tailrace, California was utterly transformed. To this moment, there had been perhaps 10,000 people of European descent in the state. Within a relatively few months there were 100,000, drawn from Europe, the Eastern American states, Latin America, and Australia, as well as, eventually, many thousands from the Orient. The mountains, the Sierra Nevada, hitherto ignored by all but the Indians, were engulfed by a rush of gold seekers. San Francisco exploded into a large American city, and thousands of people were shortly living in the new city of Sacramento, built at the juncture of the American and Sacramento

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rivers. Now a civilization had descended on California which would make heavy and complex demands upon its land and waterscape.

Ranchers and farmers were soon moving out onto the plains of the Sacramento Valley. Their herds of sheep and cattle took the place of the tule elk and antelope, which were quickly hunted to virtual extinction (some few of the former survive in protected sites), while at the same time the Indians of the Valley were dwindling rapidly in numbers and their villages were disappearing. In a tragic local re-enactment of the slaughter that had begun centuries ago when Europeans had first arrived along the eastern coasts of the Americas, at least since the 1840s the Valley Indians had been dying of European diseases as if struck down en masse by a great scythe. Settling on the now-vacated flatlands, American farmers planted that wide spectrum of crops, almost bewildering in its variety, which was thereafter to be the distinctive mark of California agriculture.

The Sacramento Valley had abundant water, a long warm growing season such as American farmers had rarely before seen, rich soils, and highly profitable nearby markets, since from the time of the Gold Rush California would be one of the most urban states in the Union. Great herds of cattle were soon in the Valley, quickly followed by sheep. As they grazed, the high thick virgin grasses of the plains were cropped down. Fruit, wine, grains, and dairy products were produced in great volumes from thousands of acres of orchards, vineyards, and pasture lands. Smoke filled the Valley as the cutting down and burning of the great forest of valley oaks, to clear the land for agriculture, began. As the tall wild grasses and valley oaks disappeared, the long, clear vistas now characteristic of the Valley opened out. Will S. Green, a young Kentuckian who helped found the mid-Valley town of Colusa in July 1850, tells us that the thick forests lining the Sacramento's banks were quickly put to the axe and saw to feed the fire boxes of the many steamboats plying the rivers, as well as the fireplaces, stoves, and industries of Sacramento and San Francisco.

Farmers taking up Valley lands avoided the immense tule marshes that occupied the lowest portions of the basins paralleling the Sacramento River, since no one knew yet how to drain them, or had the necessary resources to do so. There was, however, ample land to

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farm on the higher lands that immediately bordered the rivers themselves and tilted imperceptibly down into the tule swamps, or rose slowly upward from their outer fringes to the foothills.

Sutter County, lying in the heart of the Sacramento Valley, where it is cupped between the converging Feather and Sacramento rivers, offered a typical Valley scene in the years after the Gold Rush. Census figures reveal that there were almost 3,400 people in the county in 1860, and that in the next ten years they grew in numbers more than fifty percent to 5,030. Of 109,063 acres of land which by 1866 Sutter County farmers had succeeded in enclosing within fences, 45,424 were cultivated: 15,732 acres in wheat, 18,655 in barley. In that year the Sutter County farmers produced 83,506 pounds of butter, 1,600 pounds of cheese, and cared for almost 11,000 apple trees, as well as some 15,000 peach trees, more than 3,000 pear trees, 1,377 growing plums, and even 323 cherry trees. From 163,663 grape vines came 26,290 gallons of wine, in addition to which there was much wool, honey, corn, peanuts, beans, potatoes, turnips, pumpkins, squashes, and the like produced.²

Sacramento Valley farmers could easily ship their crops to market by river vessels. As early as May of 1849 a seagoing vessel, the bark Whiton, arrived at the waterfront of the city of Sacramento after a voyage of 140 days from New York. A square-rigged vessel drawing almost ten feet of water, the Whiton arrived "with her royal yards crossed." Before the year was out, the Sacramento River was alive with vessels. Two large steamers, each carrying hundreds of passengers, journeyed regularly between Sacramento and San Francisco, following a deep channel through the Sacramento-San Joaquin delta which still bears the name Steamboat Slough. The sails of commercial vessels stood up prominently across the flatlands downstream from the city of Sacramento, moving slowly back and forth as they navigated through the delta and the winding river above that point, maneuvering to catch the winds. In the month of September 1857, a typical harbormaster's report in Sacramento recorded the arrivals and departures of twenty-three schooners, twenty-seven sloops, and nine steamboats—the latter vessels making seventy appearances in that month in their busy comings and goings.³

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North of Sacramento, other towns quickly sprang up on the Valley floor. The mid-Valley towns of Colusa and Marysville, some fifty miles north of Sacramento, came into being almost as soon as the Gold Rush began. Colusa was laid out beside the Sacramento River at a point roughly opposite to and due west of Sutter Buttes, while Marysville appeared on the opposite, easterly side of the Buttes on the Sacramento's largest tributary, the Feather River, which flows in a north-south line down the Valley. Marysville was sited where the Yuba River, flowing swiftly out of the northern Sierra Nevada to run southeasterly across the plains, joins the Feather. It was a much more important town than Colusa, for as the effective head of navigation on the Feather it served as the principal market town and entrepot for the northern mines. Within days of its appearance in January 1850, two steamers were making regular runs between Marysville and Sacramento. In the mid-1850s the town of Oroville made its appearance thirty miles further north from Marysville on the Feather, at the point where that stream emerges from its mountain canyon to flow out on the Valley floor. In the year 1857 steamboats even called regularly at its waterfront, though this difficult navigation did not survive beyond a few weeks.⁹

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During the night of the 7th of January 1850, a great storm swept in from the west over the Sacramento Valley and the Sierra Nevada. Soon the thousands who had newly arrived in California were learning surprising facts: the Sacramento River was not only a means of transport and a source of water, it could almost overnight become a grave threat to life and property. Within two days of the storm's beginnings, plunging rains on the Sierra Nevada, where the downpours in such storms can reach an inch an hour, had transformed the rivers into raging torrents. As they poured their waters into the Sacramento, that stream in turn grew gigantic in volume, renewing its immemorial flooding cycle and sending its waters far out over the plains.

There was no levee protecting the new city of Sacramento,
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which began right at the river's banks, and within hours the entire community, for a mile back from the river, was deep under rushing waters. Houses were toppled, businessmen watched thousands of dollars in inventory wash out of their doors, and a small steamboat navigated the town's streets, delivering freight. The local Placer Times, sending out an extra edition on January 15, reported that "very few houses escaped having water on their first floors, while many have been swept from their underpinnings by the strong current." Only around Sutter's fort, and at other locations similarly distant from the river, was there dry land.¹⁰

The town of Sacramento, as these events revealed, was built in the middle of the inland sea that the Indians had warned appeared almost annually on the Valley floor. Few in the city, however, knew or talked with the Indians. As townspeople recovered from the inundation and looked about them at the waste of waters, they were not appalled and humbled by their experience but instead confident that the problem could be promptly mastered. On the 29th of January 1850, as the floodwaters were just beginning to drain away, a meeting of citizens quickly decided on the building of a levee around the town, and launched an engineering survey. When within a few days it was completed, the Placer Times remarked with complete assurance that "From the . . . examination and estimates, it will be seen that Sacramento City can be easily protected against inundations, and that, too, at comparatively small expense." In this same mood, two years earlier, the editor of the California Star had cast his eye over the great farming potential of the Sacramento Valley and had observed complacently that the low tule lands bordering the Sacramento River "can be drained at comparatively small expense. . . . Before many years, levees will be constructed . . . and the vast tract known as the 'Tulares' will be cultivated."¹¹

The levee project for the city of Sacramento, however, languished. This was, after all, not a simple public policy question. Many who lived in Sacramento had never seen a levee or understood their workings. Building such a structure would certainly be an expensive undertaking, the town was yet relatively small and its resources limited, and was a levee, people asked, entirely necessary or even practi-
cal? Would not the water simply percolate right on through such a structure and inundate the town anyway? The speculators who had sold Sacramento's town lots had assured everyone that the city's site was safe from all inundations. This was now seen to be clearly not so, but nonetheless a lingering doubt remained. Had they just witnessed a flood that would be repeated only occasionally?

Those who had arrived in California from the Southern states, where the sight of local authorities in low-country regions leveeing flood-prone rivers was doubtless a relatively familiar one, appear to have been the leaders in urging action. Northerners, however, held back. They could only decide this question on the basis of their past experiences, and in their part of the Eastern United States flooding occurred infrequently and then not with such suddenness and overwhelming impact as in the Sacramento Valley. As it happened, they were now living in one of the nation's most flood-ravaged valleys, though as yet they were ignorant of this fact. Three quarters of a century later, after generations of a painfully slow learning process, a U.S. Army Corps of Engineers officer would tell a congressional committee that the intensity of flood conditions in the Sacramento Valley was greater than in any other American river system. The river rose in flash fashion, unlike the slow-rising Mississippi. In the wide valley of that stream and its tributaries, the ratio of water to square foot of land available to take run-off was about 1.5, whereas in the Sacramento Valley it was 22.¹²

In 1850, however, this informed state of mind was far in the future, and in the new town of Sacramento, "Such . . . was the infatuated determination to believe the reiterations of the speculators [as to the town's safety]," wrote a local resident, John F. Morse, " . . . that a few weeks only [of drying out] were required to induce a confidence of future security, almost as great as that which had been manifested prior to the flood. . . . With Northern men," Morse caustically observed, "and those from the Atlantic seaboard, a levee was a species of fortifications of which they knew nothing, and nothing could exceed the unpopularity of the subject."

Natural events, as so often in later years, then burst in to resolve
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the policy debate. Under the impact of spring rains the immense snow pack in the Sierra Nevada began, in its customary fashion, to melt, and in March 1850, the rivers began rising again. Now one of the men who had been active in the earlier levee meetings, an individual of energy and personal force who carried a Southern-sounding name and a Southerner's habit of command, Hardin Bigelow, gathered

a handful of men . . . [and] commenced damming out the waters at every low point . . . finally [extending] his temporary levee almost to its present limits. Night and day he was in the saddle, going from point to point, stimulating his men to exertion. For a few days he met tide and torrent, mud and darkness, and croaking discouragements which but few men could have endured, and, to the astonishment of all, saved the town from a second inundation. As a natural consequence, everybody praised him, and on the first Monday of April he was elected Mayor of the city.  

In this spontaneous event, this personal triumph in the life of a man otherwise unknown to history, the basic form of the Valley's response to the Sacramento River, from that time to the present, was set. Bigelow had correctly forecast that flooding would be a recurrent danger, but in a crucially important decision he and those agreeing with him did not define the situation as one calling for the town of Sacramento to get out of nature's way, that is, to move back to higher land, as John Sutter had earlier done, and thereby leave a clear passageway for flood waters. Rather, without apparent thought to an alternative, they urged the people of Sacramento to dig in where they were and fight off the water, clearing out a dry space in the middle of the inland sea for themselves and their town.

The decisive fact in all of this hurried policy making was the circumstance that, in reality, Hardin and the townspeople of Sacramento knew almost nothing about the Sacramento River and its tributaries, save that they sent floods over the nearby flatlands. How big, actually, were the rivers of the Sacramento Valley in floodtime? How much water did they produce? Where was it determined to go? How deep could their inundations potentially be? If floodwaters were

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denied overflow at one point, where would they then burst out? How high did levees have to be to keep out the water not just in one, but in all, flood seasons?

None of this fundamental information about the environmental problem the people of the Sacramento Valley faced—information that was absolutely essential if an enduringly effective policy were to be fashioned—was yet known, nor would it be in more than a fragmentary way for decades into the future. The inescapable result was that the flood control history of the next half-century in the Sacramento Valley would be filed, as we shall see, not only with lofty plans and bold projects, it would be a long experience of costly failure and apparently endless frustration. The people of the Valley were trying to understand the Sacramento River, and the learning process they now had to undergo, both about the river and about the complications cast up before them by their own values and ways of doing things, would be long, surprising, and unforgiving of error.

We will observe the people of the Valley, therefore, making mistake after mistake, and yet continuing to make decisions about the river for all the world as if they knew what they were doing. In truth, given their nature, given the inner state of American political culture—which had now been transported bodily across thousands of miles and planted firmly in California—nothing else was actually possible. Midnineteenth century Americans were shaped in their most basic outlooks by the ebullient, burstinglly expansive years from the 1820s through the 1840s, the already mythical Age of Jackson, which they had just passed through. They were confident, impatient, entrepreneurial, defiant of life's limitations, and determined actively to possess and develop the enormous continental expanse that had now opened before them.

Those who had arrived in California were people who had been sufficiently courageous and risk-taking abruptly to leave their homes in the Eastern states and stream westward through a host of dangers to reach their goal. Their instinctively activist impulse was to solve (as they believed they were doing) such difficulties as they now faced in the flood-endangered city of Sacramento by some simple practical step that would force nature to behave as they wished it to. Rather
than making an adjustment to the environment and its realities, they resolved to transform it by pushing the river back, hardly entertaining the thought that they might fail.

Soon after Bigelow was elected mayor, the citizens of Sacramento on April 29, 1850 voted overwhelmingly (543–15) in favor of raising $250,000 by taxation—a princely sum for so small a community—to proceed with constructing a levee entirely around the town. The embankment that they built over the rest of the year was in reality, however, a laboriously constructed physical statement of how little they understood the problem they faced. Only three feet high and twelve feet across at its base, this first levee in the Sacramento Valley was a diminutive ancestor of the more than a thousand miles of immense levees up to twenty-five feet in height that now line the banks of the Sacramento and its tributaries. It could not do what they hoped for it. Two years later, in the high water season of 1852, it failed, to the accompaniment of bitter recriminations on all sides.15

Over the long span of years that lay before them in their adventure with the Sacramento River, the people of the city of Sacramento and of the Valley at large would eventually find out that everything said about the river being easily controlled was simply fantasy. However, they persistently avoided this reality. They were the most reluctant and laggard of learners. So optimistic were nineteenth-century Californians, so assured were they that the environment could be manipulated as they wished, that they went on proclaiming their confidence to themselves decade after decade, despite the repeated failure of their plans and projects. The city of Sacramento would have to build its levees ever higher as the years passed and at ever greater cost. Well into the twentieth century it would be still taxing itself to pay for increasingly expensive and elaborate flood control measures. At one point the city even had to bring in millions of tons of dirt to fill in its own streets, raising them to the second floor of business houses. In this fashion Sacramento lifted itself bodily, for a considerable distance back from the river, to put its daily life above the flood level.

Periods of high water in the Valley continued to recur with disquieting frequency after the flood of 1850. The people of Marysville, like those in Sacramento, had also built to the water's edge—in this

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case, to the banks of the Feather River—and in March 1852, during the same flood that breached the city of Sacramento’s first levee, they found that their town was under water. (The community would eventually withdraw from the Feather River’s banks, abandoning a number of streets.) In the countryside surrounding Marysville, “crops were flooded and a large number of cattle and horses drowned.”

In December of that year, 1852, the Sacramento Valley was again inundated, the tule lands filling even more deeply than they had in the high water of 1850. “There was no place on the west bank of the Sacramento,” a local history later observed, “between the . . . [delta] and Colusa, except the Indian mounds, that was not under water. . . . Thousands of cattle were caught in the lowlands and drowned.” A few months later, in March of 1853, a disastrous outrush of waters on the flatlands was so sweeping and violent in its effects that for years afterward the flood of 1853 was a landmark event in local memories. At Marysville the Yuba River was almost three feet higher than it had been during the previous December. The town was a lake, boats were in the streets, and the water did not drain away for two weeks. In the bottom lands next to the rivers where the soil was especially dark and fertile, where farmers had settled earliest and agriculture was the most productive, almost every farmer suffered heavy losses.¹⁶

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In the very month of the 1853 flood, enterprising miners in the mountains were discovering and putting to use a new mining technique that would drastically change the physical context of life in the Sacramento Valley for generations into the future, complicating beyond anyone’s imaginings the environmental problems that townspeople and farmers on the flatlands faced. These transformations had their origins several years before, in the spring of 1850. In that year, while the city of Sacramento was debating whether or not to build a levee, miners in and around Nevada City, which lies in a steep mountain canyon along a tributary of the Yuba River, were encountering discouraging news. As elsewhere in the Gold Rush, they had been

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working the stream placers by loosening the dirt and gravels in the streambeds with their picks and then shoveling it into long toms (short lengths of sluice box) for washing and gold extraction. They were finding to their dismay that the stream placers were quickly exhausted, that hours of labor in the streaming waters and hot sun were now producing few gold flakes in their long toms. Casting about for other mining ground to excavate, they discovered that they need not dig simply in the stream beds, rather, that they could sink their picks into the red gravelly hillsides that reared up around them and still find paydirt.

These new diggings were not nearly so rich as those in the bed of the streams, where the running water had for millennia been washing and concentrating the gold flakes, but nonetheless they still yielded precious metal. Miners tore up the entire hillside above Nevada City, eventually sinking many small shafts far down into the lower strata of the hill to get at richer gravels, which seemed to be buried at some depth. In time, a remarkable geological fact was learned: they were digging into a broad and deep river bed, dry for millions of years and lifted upward as the Sierra Nevada range itself rose, in the gravels of which thinly scattered flakes of gold were lodged. It had been, in fact, from these Tertiary-era gravel beds that the modern streams now flowing out of the Sierra had gotten their gold, washing it out of the ancient gravels as they cut down through them.

The miners faced, however, a heavy task as they dug into the gravel hillsides. Since the gold was so thinly distributed in them, many hours of pick and shovel labor were necessary to yield a living wage. A search was soon on among the more enterprising miners for a means of speeding up the process. In the spring of 1852, a tolerably effective procedure emerged. Miners would run a stream of water onto the surface of their claims and feed paydirt into it by breaking the ground on either side and shoveling it into the current. Periodically, they would shut off the flow of water and shovel the now more-concentrated paydirt into a long tom. Ground-sluicing, as this process was called, spread rapidly in the mines.

It was still an inefficient procedure, however. Interest flared
quickly, therefore, when in March of 1853 an imaginative New Englander at work in the Nevada City mines, Edward E. Matteson, hit on the solution. He arranged to have water delivered to his claim at a point sufficiently elevated above the working face of his mine so that by means of a long hose it would drop into the pit with considerable force, or, as the miners called it, head. Attaching a nozzle to this water source, he directed the jet thus produced on the hillside bluff he and his partners had been working.

The results were gratifying. Under the impact of the hurtling water, the bank dissolved into a flowing, muddy gruel, the entire mass running downslope, where it was caught in a long sluice box that had been so placed that it lay in the path of the turbid mixture. In the bottom of the sluice box, which could be made as long as convenient in order to extract as much of the metal as possible, was the usual arrangement for capturing gold: a series of riffles set crossways to the current. The gold, being much heavier than the gravel and dirt, settled behind the riffles just as, in natural conditions, it had lodged behind rocks and other obstructions in existing stream beds. Periodically, the water would be shut off and the gold recovered by scooping it out from in front of each riffle. Thus was the momentous new process of hydraulic gold mining—as it was soon termed—brought forth. 17

If a miner had water, mining ground, drainage into a nearby stream bed, and the proper equipment, with a minimum of labor he could do in a day what many men could hardly do with pick and shovel in weeks. Consequently, hydraulic gold mining, an environmentally revolutionary process, swept the California placer mining industry (and eventually spread worldwide). It was a process that expanded rapidly in conditions of absolute and complete laissez-faire—it was under no public supervision or regulation whatever, not even an ordinary business license had to be secured. Ancient Tertiary gravel beds that could be mined in this way were found to lie in a long band of territory in the Sierra Nevada, running generally north and south, which crossed the watersheds of the Feather, Yuba, Bear, and American rivers and occurred also in a few more southerly locations. As miners began work in each setting, they quickly diverted water from