Title
California's Legacy of Swamplands

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California's Legacy of Swamplands

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California is living with a legacy of swamplands. The consecutive Swamp Land Acts (1949, 1850, and 1860) were among the first federal water policies to reach newly minted western and southern states, designed ostensibly to encourage reclamation and settlement of wet and inundated areas. They are known today to have displaced indigenous cultures, retooled ecological systems, incentivized risky prospecting, and left California and large swaths of America with aging flood infrastructure projected to cost billions. However flawed, the legacy (and trappings) of the Swamp Land Acts are worthy of further consideration as a vast environmental, cultural, and technical experiment that aimed to build extensive drainage and flood infrastructure throughout millions of acres on a shoestring budget. A silver lining to this fraught process is evident in the legacy of sociotechnical innovation inspired by the California Delta, providing a valuable precedent for environmental transformations in the face of sea level rise, liquefaction, ecological degradation, and other landscape-scale threats that challenge

levee rise, liquefaction, ecological degradation, and other landscape-scale threats that challenge conventional responses due to their distributed and complex geographies.

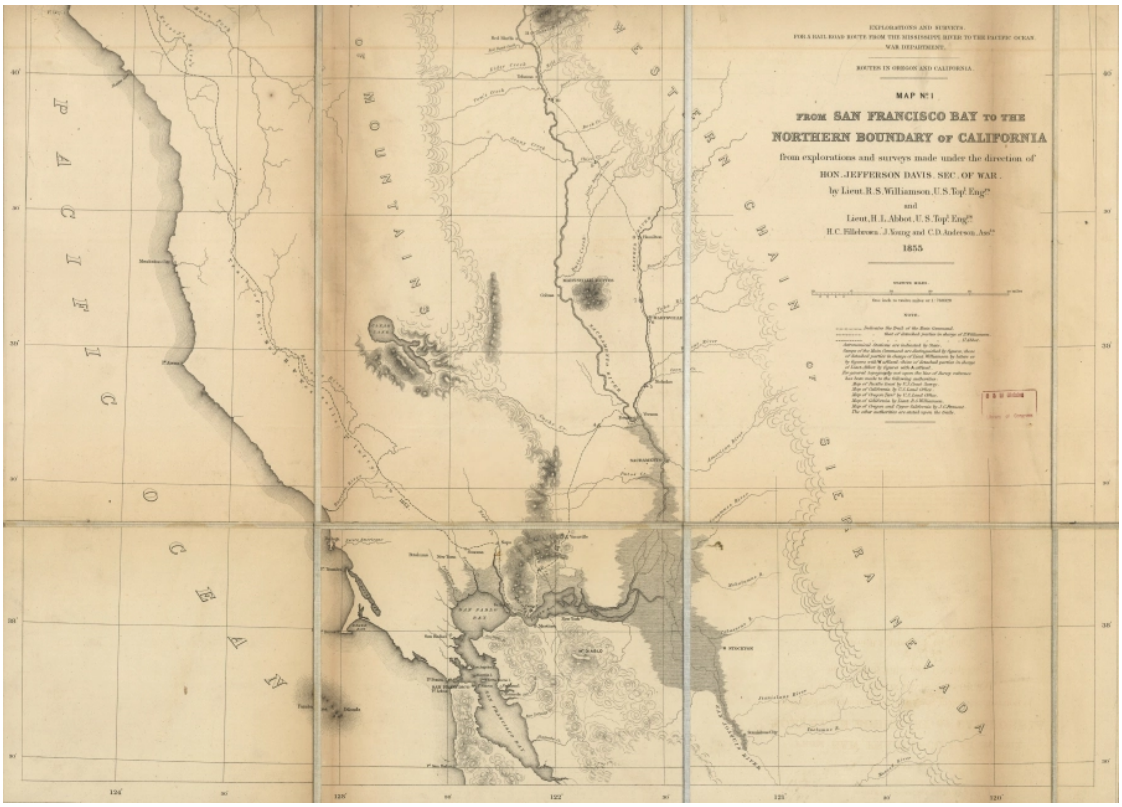
Ambiguous Terminology Becomes Federal Policy

In the early American Colonies of the eastern seaboard the word "swamp" referred to a "woody tract in which there is considerable undergrowth" and was not necessarily associated with wetness. The relationship of swamp to wetness evolved throughout the late seventeenth and eighteenth centuries and was often understood in opposition to dry upland that was suitable for development. Etymologically, this makes sense as the English usage of the word refers to a "soft plashy ground," and the Germanic root *schwamm* refers to a sponge or "a structure adapted to sop up water."[1] During this period a swamp was loosely defined as "land barely safe from inundation," but the meaning continued to evolve through common usage "to mark a particular condition of soil—not inundated intermittently, as were meadows; not extremely boggy, as were marshes, and yet a soil too wet for easy going on foot, or for actual cultivation with the plow."[2]

By the nineteenth century the word "swamp" was commonly used in association with the qualities of earth related to excesses of water, and it was in this period that swamps also became directly associated with the need for improvement. For example, in a publication of the geological dictionary the of the New England Farmer (1822) a swamp (or bog) is defined as "piece of land with a wet miry soil." Followed by the assertion that, "Such land is unprofitable, or even a nuisance, until it be drained. But after draining it becomes the best of soil, producing the greatest of crops."[3] A swamp, therefore, became nothing more in the mind of farmers, landowners, and legislators, than a wet piece of ground to be improved. It is from this sense of the word that the Swamp Land Acts (aka Swamp Land Grants) of 1849, 1850, and 1860 collectively transferred 64,895,415 acres of swamp and overflowed lands controlled by the Federal Government to fifteen states with large areas of miry ground within their boundaries. Today, yesteryear's swamps are known for their ecological designations as riparian zones, wetlands, marshes, vernal pools, flood plains, bottomland forest, etc., yet it was the ambiguous definition of the early 1800s that became law.

The lure of "improvement" alone does not wholly explain the nineteenth century preoccupation with swamps. Wet ground was tricky to colonize, less desirable, and was often the last area to be developed, leaving much of it as *terra incognita* (land unknown). In this context, swamps also became a cultural designation, highlighting divisions between high and low, cultivated and wild, improved and unimproved, cultured and primitive—a lore writ large in stories of escaped slaves and recalcitrant Indians.[4] Swamps were the places of outlaws and outsiders in the collective imagination, and draining them was a cultural project played out on a massive geographical scale under the partial guise of improvement. Nevertheless, a semantic boundary between wet and dry established the legal and spatial scope of the Swamp Land Acts, and the inherent mutability of wetness led to confusion and abuses.[5] It is on this tenuous footing that we must comprehend the development of American

swamps, including the Central Valley of California, not as a cohesive top-down federal drainage plan, but a distributed sociotechnical and cultural experiment designed to colonize and clarify the boundary between the *cultivated* and *uncultured* by technological means.



From San Francisco Bay to the northern boundary of California: from explorations and surveys (1859), courtesy of the Library of Congress.

The Swamp Land Acts

Swamp and overflowed lands were a scourge on the nineteenth and early twentieth century American landscape, harboring disease, reducing productivity, providing refuge for cultural outsiders, and generally slowing development. The reclamation of swamplands catalyzed investment in previously unwanted federal lands, changed settlement patterns, displaced native cultures, and catalyzed technological innovation and private investment through non-cash incentives. The first Swamp Land Act, titled "An Act to aid the State of Louisiana in draining the Swamp Lands therein," was passed by Congress in 1849, "to aid the State in constructing the necessary levees and drains to reclaim the swamp and overflowed lands therein, the whole of those swamp and overflowed lands, which may be, or are, found unfit for cultivation, shall be, and the same are hereby, granted to that State." The act transferred 9,493,456 acres of federally owned swamp to the state of Louisiana, contingent on the sale and reclamation of the property, and the use of funds resulting for the sale to build levees. It is with this policy mechanism that the first federally backed levees were constructed along the Mississippi River using the capital and sweat equity of private citizens coupled with the disposal of lands in the public domain. A windfall for those who could afford a dollar an acre and the slave labor

lands in the public domain. A windfall for those who could afford a dollar an acre and the slave labor to build a levee.

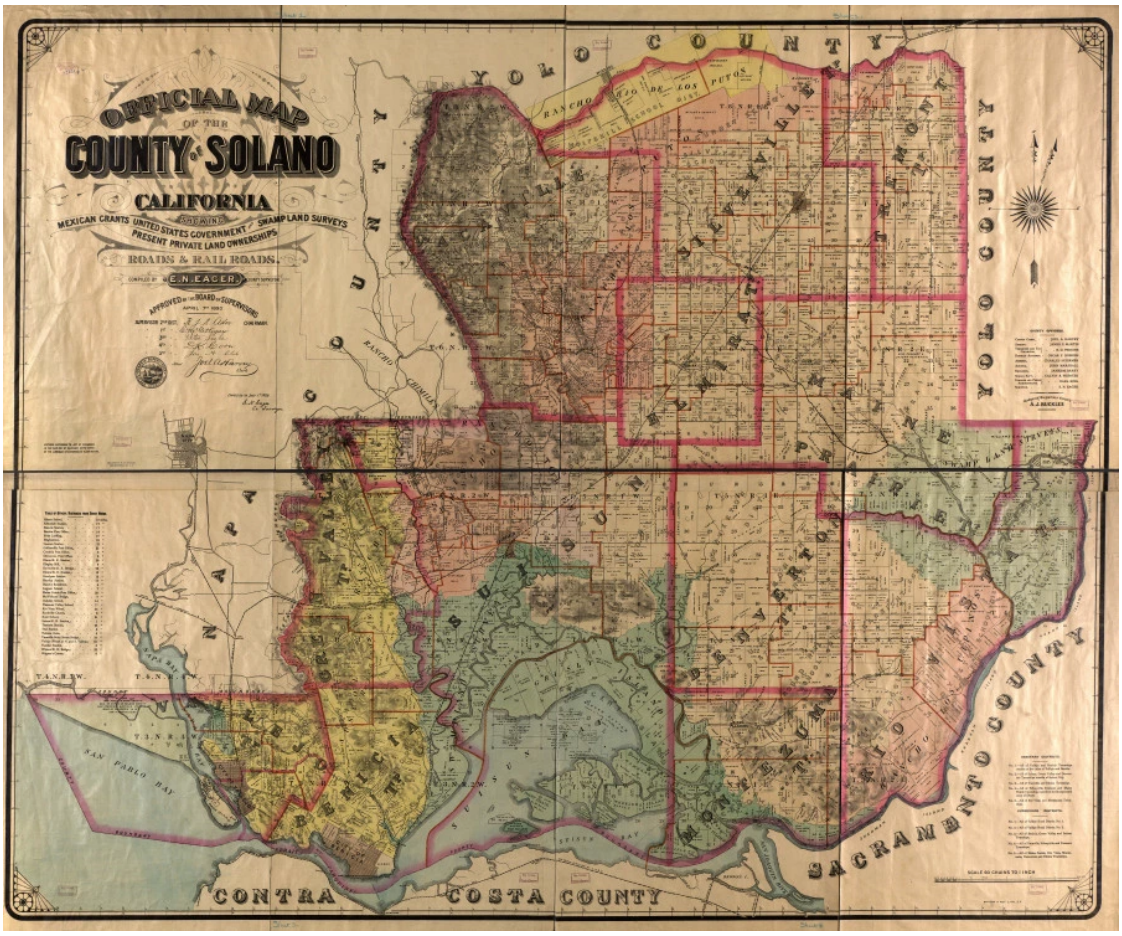
The second Swamp Land Act of 1850, "An Act to enable the state of Arkansas, and other states to reclaim the 'swamp lands within their limits,' expanded the precedent established in Louisiana to Arkansas, Alabama, California, Florida, Illinois, Indiana, Iowa, Michigan, Mississippi, Missouri, Ohio, and Wisconsin, ultimately transferring 50,409,348 acres of wetland to the states. In California, 2,192,975 acres were transferred to the state for sale and reclamation, consisting mostly of extensive tule marsh in the Central Valley, what is today known as the Sacramento–San Joaquin Delta. The third Swamp Land Act passed in 1860, transferring 5,002,611 acres to Minnesota and Oregon. Collectively, the three acts of Congress shifted 64,895,415 acres from federal public domain to the states so that private citizens and eventually reclamation companies would improve these areas. States served only as intermediaries for the sale of land to private landowners who were ultimately responsible for improving the land, and any leftovers too hard to reclaim or distant would remain property of the state. In true American style, individual landowners and corporations became default infrastructuralists, building the levees, installing the drains, and edifying the countries most extensive water infrastructure in a freewheeling manner premised on radical environmental transformation and profit.

An Ancestral Delta is Designated a Swamp

The pre-contact delta of the Sacramento–San Joaquin was as a vast, relatively flat, inland estuary of tule grasses and forbes, rich with water fowl, game, and fish, flanked with evergreen oaks in areas of higher ground. The ecology of this massive delta was fed by extensive snowmelt from the Sierra Nevada, ample sunshine, and deep organic soils stabilized by dense tule grasses that in combination act like a sponge and sieve to retain water and sediment washed down from the mountains. Ecological assemblages supported a diverse indigenous population, estimated in the tens of thousands, and distributed through the diverse waterways that converge in California's Central Valley. [6] Tribes of the Interior Miwok, Maidu, Yokuts, and other speakers of the Penutian language lived in relative balance with the cycles of the riverine and valley ecosystems with little modification of the larger environment. Designation of the delta as swamp reframed the landscape as something in need of improvement—a landscape to be drained, leveed, cultivated, and assimilated.

The federal Swamp Land Act, initially known as "An Act to enable the state of Arkansas, and other States to reclaim the 'swamp lands' within their limits" (28 September, 1850), bestowed responsibility of reclaiming overflowed and swampy land under the to the state of California, which was only granted Statehood on 9 September of the same year. Most of the territory subject to the Swamp Land Act was in the vast inland estuary known as the California Delta, an area that was to rapidly urbanize, and subdivide, leaving swamps as the last bastion of *terra incognita*. Ambiguities of terminology, mapping, finance, and confusion at the state and federal levels bungled much of the process, yet the

delta was altered irreparably and a patchwork of reclamation works were initiated in the 1850s and ’60s, and continues today in the form of levee maintenance and drainage.[7]



Official map of the County of Solano, California: showing Mexican grants, United States government and swamp land surveys, present private land ownerships, roads and railroads (1890), courtesy of the Library of Congress.

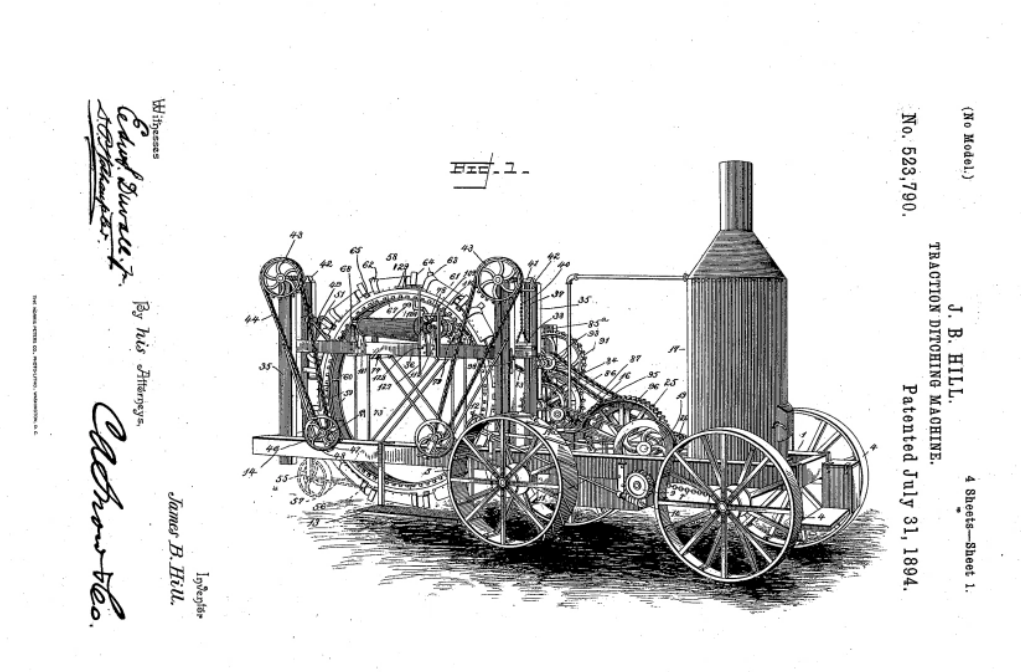
Land prospectors, reclamation companies, and their lawyers rushed to acquire the delta. Sale of lands in the delta began in 1851 when John Booth and David Calloway bought 640 acres, obligating them to reclaim the land in five years or risk losing their property. This proved too high a bar for most investors, and by 1858 the provision was revised so that only half the land must be reclaimed within the five-year term.[8] The state found mapping the swampland difficult, and some in government were resistant as a vast swath of prime inundated grasslands were already being profitably managed by the state. Also, the gold rush in the Sierra Nevada Mountains moved an estimated five inches of material annually to certain areas of the Central Valley, essentially raising the land and threatening its swampland designation. Nevertheless, by 1865 ten miles of levees had been constructed and two sloughs blocked, setting in motion a wholesale reconfiguration of the delta by individual landowners and reclamation companies within decades. The work enacted in this landscape was premised on improvement, drainage, and modern agriculture, a process of acculturation that decoupled the natural hydraulic cycles and marginalized the cultural practices of the indigenous people who depended on it.

depended on it.

Anglo and European Origins of Swampland Technologies

Technology played a deterministic role in the transformation of swamplands across the United States. In low-lying areas at risk of inundation levees were constructed around newly parceled land, and in areas where waters were perched or poorly draining, subsurface drainage tiles and ditches expedited the removal of ground and surface waters. The drainage tiles and levees borrowed from European and Anglo precedents in a far-reaching technology transfer across the Atlantic Ocean. This was also a clash of cultures in which the ancestral landscape processes were replaced with new European modes of landscape management.

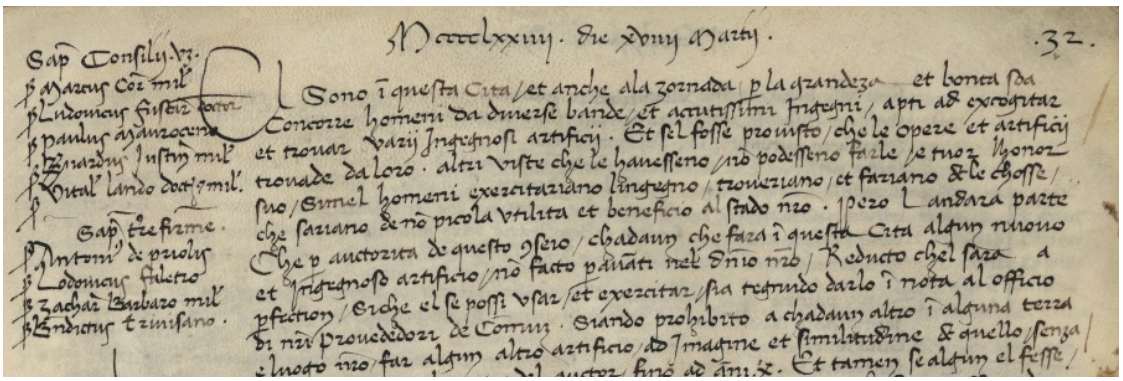
Throughout the Midwest in Ohio, Iowa, Missouri, Indiana, and Wisconsin, drainage tiles were laid beneath millions of acres of wet prairie and lowland forest in an attempt to civilize the swamp. Drainage tile technology arrived in the United States in 1838 when John Johnston installed horseshoe-shaped tiles on his Seneca Lake Farm in New York.[9] The original tiles were created using the Scraggs Patent Tile Machine, which was imported from England by the businessmen Benjamin Whartenby and John Dalefield. English origins of American drain tile technology are not surprising, since the type of wetness associated with the American 'swamp' was typical in soggy, old England. By 1500 a considerable portion of marshy British fenlands had been reclaimed to create arable land, and royal patents were granted by decree for drainage system.

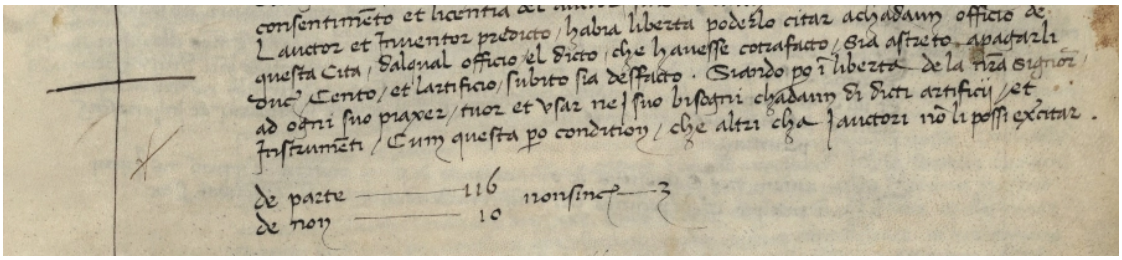


American boosters of land drainage wrote elaborate treatises to promote the technology and drainage process. Two of the most widely circulated guides were published by John H. Klippart "The principles and practices of land drainage" (1861) and George Waring "Draining for Profit and Draining

principles and practices of land drainage" (1861) and George Waring "Draining for Profit and Draining for Health" (1867). Notably, Waring was the engineer for the design and construction of Central Park's (NYC) Drainage system, which was the largest drainage project of the 1850s, requiring more that sixty miles of clay pipe and relocation of a historic African American community that lived in the urban swamp that is now known as Central Park.[10] Further west, technical guides like Kippart's book, commissioned by the Ohio State Board of Agriculture, became the template for draining the Black Swamp, one of the largest lowland forests in the region. The Black Swamp was substantially reclaimed through the invention of J.B. Hill's Buckeye Steam Traction Ditcher, a machine that expedited the ditches necessary to lay drainage tiles. Drainage technology became a means through which to transform bogs, woodlands, and marshes to productive acreage and to shift cultural norms from hunting and foraging to European agriculture – and when viewed through the lens of a hegemonic past, drainage became an effective tool to decimate and displace native populations who depended on in-situ ecology and hydraulic system for sustenance.

Levees were also European in origin. The word "levee"—a manmade embankment built to prevent flooding—finds its etymological root in the French *levée*, "to lift," and can be traced through its English usage to the founding of New Orleans and the Louisiana territory in the first decades of the eighteenth century. The early French settlers of New Orleans and their slaves built levees to protect the dubiously situated city, borrowing the technology from European dykes and embankments observed in the Netherlands and France. A century or so after the first levees were built in Louisiana; similar levees were being constructed in the post-gold rush deltaic landscapes of the Sacramento–San Joaquin Rivers to "improve" swamplands for agricultural uses. At the time of the Swamp Land Act, a significant shift was afoot with the abolition of slavery in western states and territories, serving as a precursor to the Civil War (1861-65). Slaves are not known to have built the levees of the western states, where slavery was outlawed. Instead levees were built by radical new devices, such as hydraulic dredges, invented to hasten the extraction of gold. Although the idea of levees was European, the methods evolved along the western frontier from the unique contingencies of the American landscape in combination with progress on the "useful arts."[11] We know of the technological changes occurring in the western landscape through an extant record of machines documented by historians, and more accurately through the archive of the United States Patent and Trademark Office (USPTO) where many of the speculators and inventors submitted patents for their devices to transform the American landscape.





Venetian Statute of Monopolies, 1474.

Amazingly, the tradition of sociotechnical innovation that was to transform the western frontier can be traced back to Venice. Venetians issued the first patents for land reclamation and dredge technology in the early fifteenth century in order to urbanize the lagoon, and codified the first law to incentivize innovation with the Venetian Statute of Monopolies in 1474. The statute encouraged thoughtful prospecting in manufacturing and industry, as well as the "mud technologies" that were developed and transferred between the Netherlands, Venice, France, and England.[12] Decades prior to the drafting of an official patent law, patents were issued for the construction of Venetian canals and for land reclamation to attract experts and inventors to the city and territories of Venice.[13] Centuries later the English Statute of Monopolies (1624) helped to create conditions for the Industrial Revolution, and laid the groundwork for the inclusion of patent rights in the U.S. Constitution.[14]

At the time of the first Swamp Lands Act (1849) the U.S. Patent Office had been shifted to the newly formed Department of Interior from its origins in the Department of State. The Department of Interior became known as the de facto 'department of the west' for its involvement in the affairs of western states and territories. The Department of Interior was created through a strategic reorganization of the Census Bureau, General Land Office, Office of Indian Affairs, and Patent Office which collectively dealt with interior improvements, migration, public lands, etc. Patent innovation paralleled western expansion, and as benefactors of the Swamp Lands Act adapted to the local conditions a robust legacy of technological innovation was documented by the patent office. The scale and the unique geography of American swamplands became fodder for innovation—a process revealed in the California Delta through the convergence of settlement, geography, and technology that came to together as part of the Swamp Land Acts.

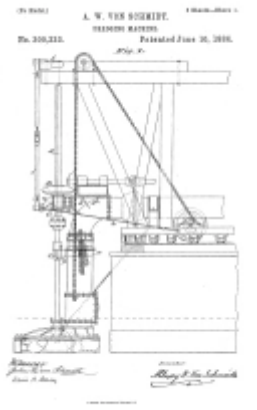
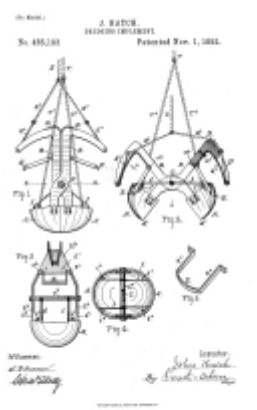
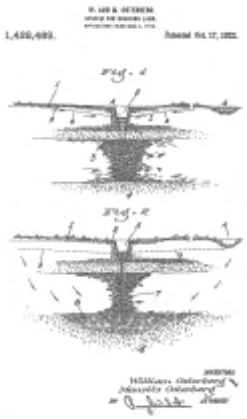
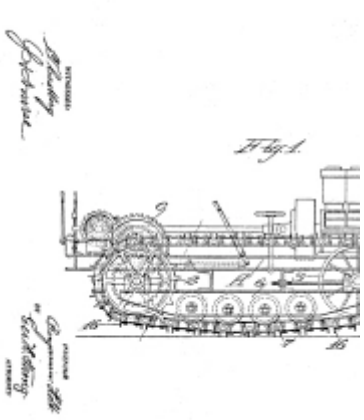
California Swamps and Technological Change

The unique geography of the California Delta inspired technological change. However imperfect, the Swamp Lands Act was a vast sociotechnical experiment designed to territorialize and assimilate the untamed lowlands. Most of the early individual landowners and private reclamation companies completed drainage and levee work in the Delta with little oversight from the state government.[15] As a result, reclamation proceeded as a loose set of local experiments, technologies, and funding sources, and not from a centralized plan. The free market approach to reclamation led to the invention of new levee construction method, drainage systems, and dredge boats. Many of which are

chronicled in the archives of the USPTO. If a silver lining exists to the legacy of California's swamplands, it is in the evidence of human ingenuity and invention inspired by the delta frontier.

From 1850-1930 incredible new hydraulic, bucket, and clamshell dredges were developed to break thick tule grasses and build levees. Across the region, in cities from San Francisco to Stockton, inventors such as Allexy W. Von Schmidt and John Hatch developed hydraulic and clamshell dredges to levee reclaimed land newly reaped and irrigated.[16] A mindboggling array of dredgeboats worked the Delta, a history of innovation vividly depicted in John Thompson and Richard Dutra, *The Tule Breakers: The Story of the California Dredge*. Many of the experimental technologies pioneered in the Delta were later applied throughout California and San Francisco Bay on reclamation projects that altered the morphology of the entire region.

Others technologies were invented to drain, contour, and reap the land. For example, in areas with perched water tables, William Osterberg of Modesto developed a system to drain lowlands by drawing water to the surface through a series of wells and channels, passively lowering the water table in a given area. And for areas in need of contouring James Porteous invented the Fresno Scraper to move soils and facilitate drainage. Levees and drainage systems revealed virgin soils ripe for agriculture. Too soft for conventional tractors, the unique composition of organic soils inspired agricultural innovation. For example, Benjamin Holt, inventor or the Caterpillar tractor, developed his technology specifically to traverse the soft ground of the Delta. His first prototypes utilized massive wheels to distribute the heavy load of farm equipment, and later evolved the caterpillar type traction that revolutionized farming and warfare.

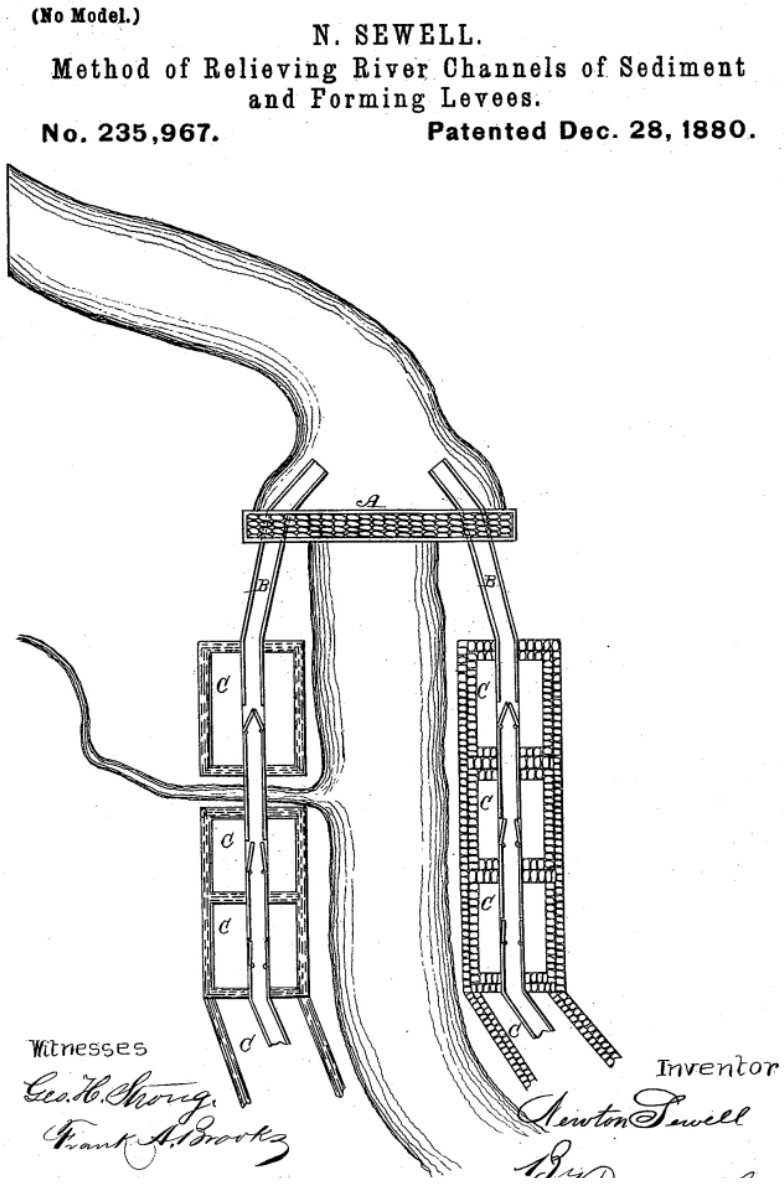





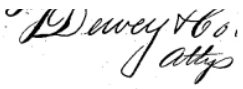
Delta Visionaries—Newton Sewell and Frank V. Wright

Evidence of a true geography of innovation (like Silicon Valley) is also evident in the unbuilt and less well-known inventions created in relations to the swamplands of the California Delta. Although numerous technologies were developed in (and impacted) the region, a few clearly illustrate the dynamic reciprocity between the California Delta and the frontiers of technological innovation

dynamic reciprocity between the California Delta and the frontiers of technological innovation, including patents issued to Newton Sewell of Yuba, and Frank V. Wright of Alameda.

On 28 December 1880, Newton Sewell (1821-1902), a county assessor and landowner in Yuba, was granted U.S. Patent 235967, which describes a passive hydraulic method for levee formation through the construction of check dams within sediment-laden rivers. The dams would divert accumulated sediment to a series of settling enclosures that in turn would become a levee. During the gold rush, sediment input into the Sacramento–San Joaquin almost choked the Delta.[17] Sewell's patent for a "Method of relieving river channels of sediment" utilizes a series of small subsurface dams and diversion channels to settle out sediments and reclaim new land. The design is topographical in nature, correlating the slopes of rivers, dam sequences, and sediment enclosures to the locations of levees.

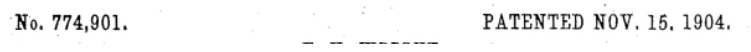


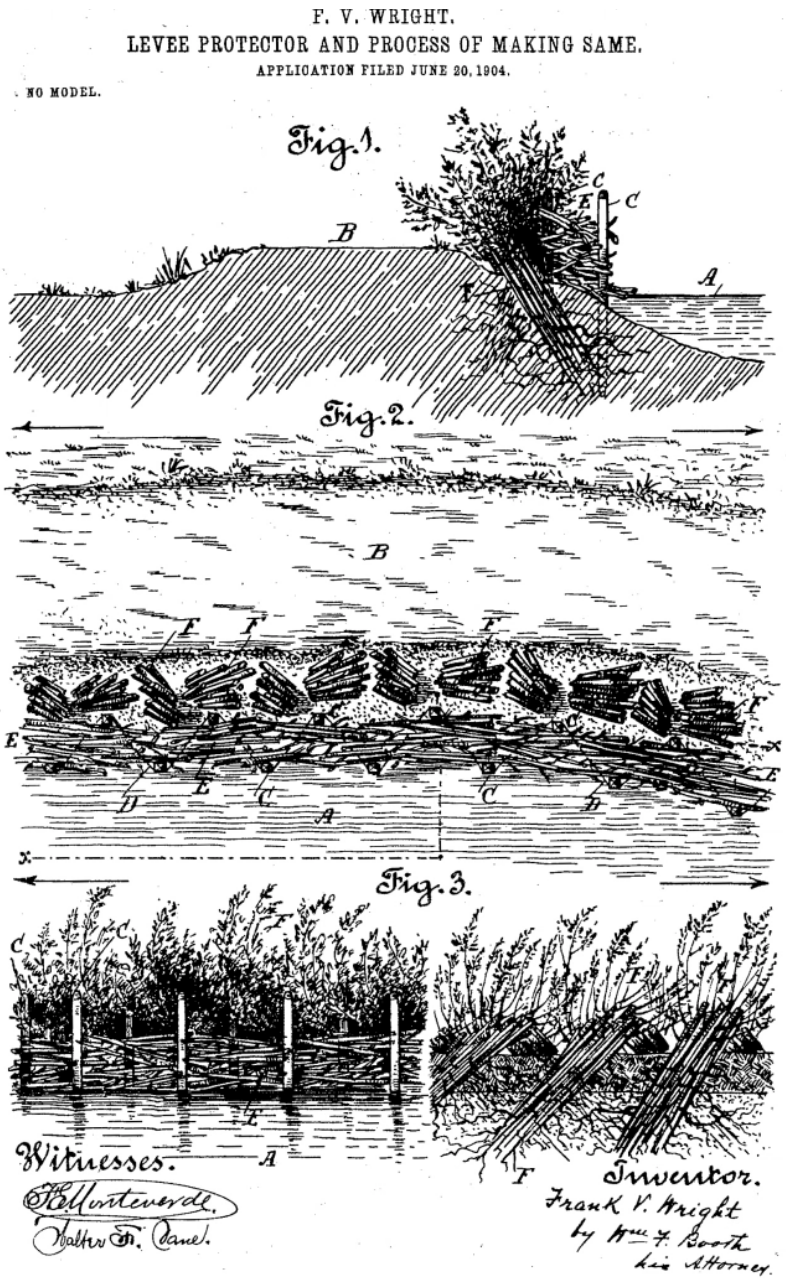


Sewell's invention was conceived in the later years of hydraulic dredging practices for gold mining in the upper reaches and tributaries to the Sacramento–San Joaquin Delta—a mining process that almost choked the Delta and San Francisco Bay with sediment. During this period, an estimated 300 million cubic meters of sediment were moved by rivers and creeks from the Sierra Nevada Mountains into the Central Valley and San Francisco Bay—enough material to cover 380 square miles at a depth of one foot. Sewell's design is noteworthy not only for its engineering of the intrinsic fluvial processes of rivers and for linking levee formation to topographical change in river systems, but also for its mastery of regional source-sink sediment budgets in river systems by utilizing the sediment generated upstream in the distant Sierra Nevada Mountains to build levees downstream in the productive alluvial plains of the valley. Sewell also suggested that the system might be used to "reclaim" or raise low-lying areas through the addition of sediment—an interesting and farsighted proposal given the massive subsidence in the Delta today resulting from extensive levee construction, agriculture, and oxidation of rich organic soils.

This process is quite simple, utilizing a series of low-crested check dams to raise the level of water and divert sediment-laden water into settling enclosures, allowing for levee formation at an increased height relative to the original elevation of the river. Once the levee has formed and the dam is removed, the river elevation recedes to normal and the levee remains elevated. When envisioned serially along the reaches of a river system, a mosaic of leveed lands can be envisioned, similar to the natural bars and highlands formed intrinsically by migrating rivers. Importantly, the system was developed for implementation along the rivers of central California, between the gold rich lands of the Sierra Nevada and agriculturally productive lands of the California Delta, a statewide sediment management plan disclosed in patent.

Patents issued to Frank V. Wright also reveal how geography inspired innovation in the Delta. Mr. Wright was a businessman, residing in San Francisco and later Alameda with a family land holding (Wright Tract) in the Sacramento–San Joaquin Delta. His four known patents reimagined the function of levees and even suggested radical new forms of landscape infrastructure, providing a window into how a process of technological innovation transforms something as seemingly banal and ubiquitous as a levee berm.



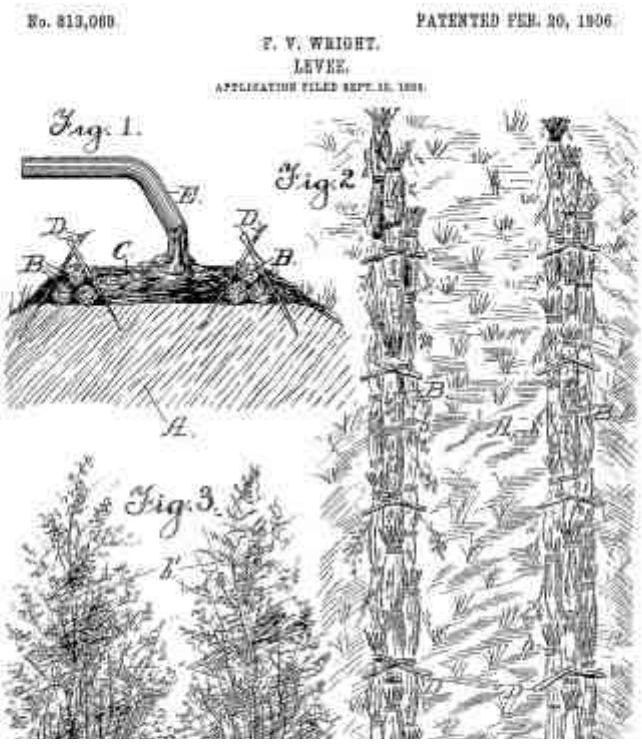

F. V. WRIGHT.
LEVEE PROTECTOR AND PROCESS OF MAKING SAME.
APPLICATION FILED JUNE 20, 1904.
NO MODEL.
Fig. 1.
Fig. 2.
Fig. 3.
Witnesses.
Inventor.
Frank V. Wright
by Wm. F. Booth
his Attorney.

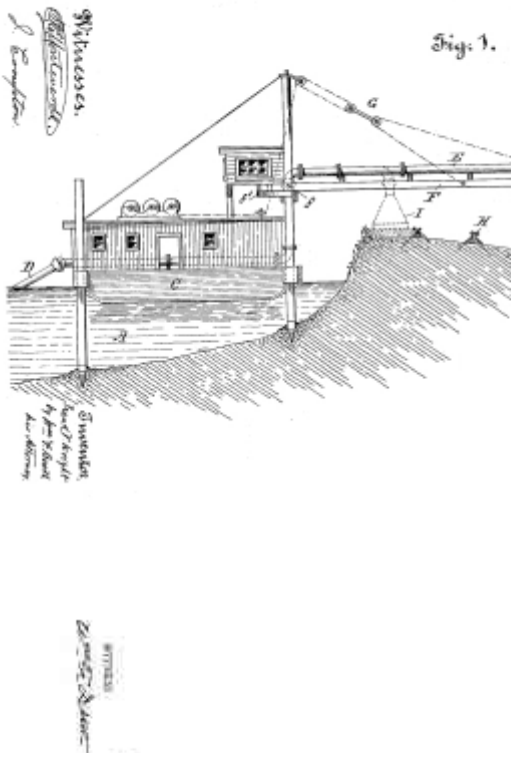
Wright's first patent, US774901, for a "Levee Protector and Process of Making Same" was granted in 1904. The patent discloses a technique of bioengineering that utilizes live stakes and woven branches to protect earthen embankments from erosion. Bioengineering techniques, such as those described by Wright, may have been novel enough to warrant a patent in America and the burgeoning California Delta, but similar techniques have a long history of informal innovation dating back to ancient China and Europe where willows and bamboo were used to stabilize the banks of rivers. [18] Nonetheless, a patent was granted.

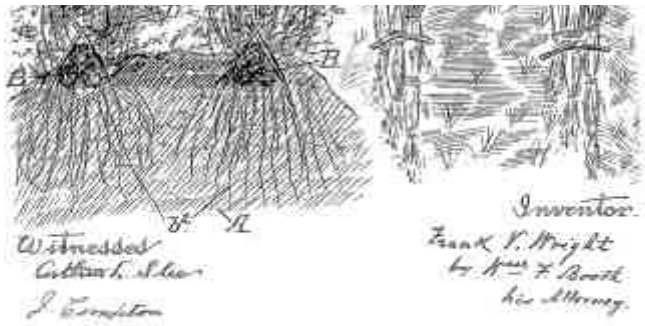
A second patent (US80800) issued two years later in 1906 for a "Levee Building Suction Dredge" in combination with his consecutive patent (US813069) simply for "Levee" disclose truly innovative

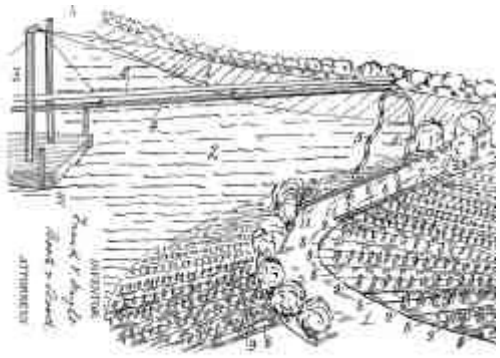
methods of levee building that integrated hydraulic dredging techniques with bioengineering. The patents describe methods to create a hybrid mechanical and biological system that captures sediment slurries within the roots and branches of living fascines and stakes of plant material to literally grow levee berms. This imaginative biomechanical system orchestrates the growth of plant material that retains sediment with the mechanical process of hydraulic dredging into a truly novel hybrid. The patents invite us to imagine a process of levee building that choreographs both plant growth and a river's sedimentary cycles into a new landform 'levee' building process at the intersection of biological, riverine, and mechanical systems.

Frank V. Wright's swansong, US1262898, a "Method of Concurrently Maintaining and Cultivating Levees," advances his aforementioned innovations and discloses a new art of growing crops, and raising levees simultaneously in a new multifunctional levee that integrates cultural practices of agriculture with flood protection. In its most basic form, Wright's system maintains levees through the furrowing irrigation trenches and the addition of sediment slurry as irrigation water to berms. Wright claims that addition of sediment to the berms reduces cracking due to dehydration and increases levee height incrementally by the addition of new sediment and organic materials. His process orchestrates the application of fresh, sediment-rich water, from adjacent waterway to irrigate crops and thus cultivates new ground in a manner reminiscent of Mexico's Chinampas.[19] The patent is striking for its durational qualities, but also for its evocation of contemporary themes of multifunctional landscape infrastructure that integrates programs and cultural practices. One can envision the combination of wet soil and sediment leading to a healthy process of soil formation that evokes the process of wetland growth native to the Delta landscape.









Environmental Challenges of the Future

The legacy of swamplands is written in the morphology of the Delta, in California's wider water infrastructure, and in the annals of the United States Patent and Trademark Office. As we look toward the future of the California Delta and water infrastructure in the state of California it is easy to focus on the eminent crisis caused by subsidence, failing levees, degraded ecosystems, and threats of saltwater intrusion. Yet the hastily drafted Swamp Lands Act of 1850 also reminds us of our resilience and the potential to enact massive environmental change in the face of daunting environmental imperatives. The 'swamp' was the scourge of the eighteenth century American landscape that was eradicated through a vast sociotechnical experiment with limited centralized planning. As we face the current day 'evils' of sea level rise and climate change we might look to the precedent of the Swamp Land Act as a template for decentralized responses to environmental imperatives at the frontier of technology and society.

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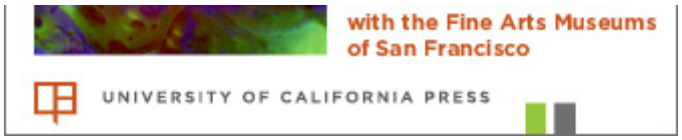

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