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This article discusses the ways in which fire was used for about a century as a tool in land preparation in the Sacramento-San Joaquin Delta. The relative impact of this approach was greatest on virgin land, but fire was also used on a recurring basis until the 1950s in the management of land where cropping of potatoes and sugar beets was repetitive. Although such intentional burnings of the land occurred more often and had major impact prior to the 1920s and 1930s, the nature of fire events and their effects are largely unstudied.

These practices are described below for perspective on the findings of George Newmarch about the subsidence process. According to Newmarch, oxidation and shrinkage, natural consolidation, and removal by wind were relatively more important than burning for lowering the surfaces of peaty land. Recent investigators attribute about 30 percent of aggregate subsidence to wind erosion and burning, about 30 percent to consolidation, and about 40 percent to oxidation.¹

Although an exhaustive search of the principal sources of information on fire events has not been done, enough has been gleaned from newspapers and early public documents to warrant an account and analysis of the historic experience. Readers will recognize that events discussed in this article are cited in one or another newspaper by chance, as were the author’s findings as he searched for documentation on other matters. Nevertheless, the record is reasonably clear that fire has been an important factor in shaping the topography and soils of the Delta.

This discussion of fire in the Sacramento-San Joaquin Delta begins with a description of tule burning prior to reclamation and proceeds to a description of “fire-plowing” virgin peat. The article reviews accidental fires in the soil and levees often linked to grain fires and the adoption of fire as a basic tool in preparing the land for repetitive croppings of potatoes and sugar beets. In addition, it discusses modes of containing and suppressing fires in the peaty lands.

The estuarine delta of the Sacramento and San Joaquin Rivers embraces about half a million acres of wetlands about fifty miles northeast of the Golden Gate (Map 1). One and one-half centuries ago, these “tule lands” or “fresh water tide lands” bore a cover of bulrush (Scirups spp.) and reed thickets, except where natural levees rose high enough for clumps and strips of willows to develop. The natural levees became higher and broader

headward along river channels, supporting corridors of woodland of diverse species.

As noted by observers in the 1860s and the 1870s, thousands of acres of natural meadows occupied elevated sandy soils in the Delta. Such cover was attributed to burning by the Indians. Swards of native grasses and clover were particularly evident on upper Union and Roberts Islands (Map 1). Observers described “beautiful meadows” on loamy areas of Andrus Island, and they probably existed on similar high ground elsewhere. In the droughty years of 1864–65, fifty thousand tons of “very fair quality” hay were shipped elsewhere in the Sacramento and San Joaquin Valleys from the southern Delta.²

The height and breadth of natural levees along the Sacramento River were sufficiently great headward of the Delta’s central third that settlers were drawn to them in large numbers in the wake of the California Gold Rush. Around that time, some settlers occupied the banks of the San Joaquin River to the south of Stockton. By and large, the islands of the central Delta had little area free of tidewater and tules to attract settlers before the late 1860s and 1870s, when speculators undertook projects to drain the tracts.³

During the course of seven to ten thousand years of post-Pleistocene rise in sea level, about half the area beneath the estuarine wetlands in the Sacramento–San Joaquin Delta was transformed into peat.⁴ The peat underlay all of the central Delta’s tule islands, which were shaped like broad shallow saucers.

In the northern and southeastern thirds of tidal wetlands, however, rising and broadening natural levees flanked more troughlike backswamps, where shallow beds of peat lay beneath the tules. Especially at their upstream margins, the areas of backswamp between the distributaries of the master rivers were subject to accretions of sediment from overbank flow. Hence, the roots and remains of tules were more thoroughly mixed with alluvium there than in the central Delta. The Delta’s beds of peat thinned out toward the east, northwest, and southwest as the floor of the Central Valley edged higher above the floodplain.

Thirty to sixty feet of peat and organic-rich muck lay beneath the central Delta and its western apex before settlers transformed the islands into arable land by raising levees and excavating drainage systems. In reclaiming these tule islands, however, they degraded the substance of the peaty land. In the central Delta, large parts of the island floors have

subsided between ten and twenty-five to thirty-two feet below the surface elevation of the original wetlands. The loss of elevation across island floors currently proceeds at a rate of about three inches per year.\(^5\) Thinner deposits of peat at the Delta’s periphery have entirely disappeared since reclamation.

The wasting process was most dramatic on virgin land, where workers used fire to remove tules and transform coarse mats of roots and peat into seedbeds. Sometimes the fires resulted from accident or malice, sometimes as a form of diversion. It was not uncommon for fire to escape. Together with the natural processes of oxidation and shrinkage, which occurred as the peat dried, removal of the duff by wind and wave contributed to the wasting process.

**Fire in the Delta Before Reclamation**

Writing in 1868, T. F. Cronise described the tule lands of the Sacramento–San Joaquin Delta as they appeared on the eve of the first concerted effort to reclaim them for agriculture:

> Along the San Joaquin River, which spreads out into numerous sloughs, there is in the northwestern part of [San Joaquin] county, an immense expanse of tule marsh—not less in the aggregate than 200,000 acres, much of which is covered at all times by a few inches of water, nearly the whole being submerged at high stages of the tide. Late in the season, however, before the streams have been raised by the winter rains, large sections of these lands becoming dry on the surface—the dense body of rushes, the growth of former years, having meantime wilted and dried up, the latter often take fire, and burning with terrific fierceness for days in succession, many thousand acres are burned over and stripped of both the dead and living tules. In all the counties containing large tracts of tule lands, these fires are common, generally occurring in the fall and winter. Nor are these conflagrations confined wholly to the rush lands. They often break out in the grass and herbage, which late in the summer becomes dry as tinder, and sweeping over the plains and mountains, leave millions of acres scorched and blackened, though the heat is not generally sufficient to injure the forest trees or large shrubbery.\(^5\)

Understandably, Cronise and other observers described fire events across a continuum that included fields, the tall tules of the wetlands, the seasonally green grasses of the wooded and open plains of the Central Valley, and the brushy and woody slopes of the Coast Ranges. Seen from Antioch, such burning in 1878 yielded “evening fireworks on a grand scale and without expense. For miles in every direction during the still evenings, bright lines of fire [could] be seen reaching over the hills and creeping through the ravines.”\(^7\)


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Other observers, from Antioch (October 1873) and Sacramento (January 1869 and 1871, and November 1872), noted extensive fires raging in the tule lands. One fire in the Yolo Basin during November 1872 had high winds that fanned burning tules into a blaze and lit up the whole countryside in spite of rain. The resulting destruction of pastures required the removal of stock to commercial feedlots until arrangements could be made to place them on new pasture or range. In anticipation of wintertime flooding of tule lands, many livestock were moved to higher ground.8

The destruction of pasture areas could be extensive. At Union Island, for instance, fire damage was so widespread in September 1877 that nine thousand sheep had to be transferred to Bradford Island by steamboat. In 1871, fifteen hundred sheep were lost about five miles northeast of Byron in a tule fire attributed to arson. In July 1873, a rider and mount were severely burned near Antioch while driving cattle out of another tule fire and the horse’s hooves broke through the surface crust into a bed of hot ashes.9

Fire-plowing in the late 1860s and 1870s

When the reclamation of the central Delta began in the late 1860s and the 1870s, the common procedure to prepare the virgin tule land for sowing was to enclose and ditch it, then to set it afire. Burning might proceed in two steps, the first designed to remove the cover while the sod was still damp and the second to break the land, or “fire-plow.”10

Although one observer in 1869 considered the practice of burning tule land at Sherman Island “not commendable,” developers of land believed it the least costly and most rapid way to prepare land for cropping. Moreover, some observers believed that tule land “in its wet state... is too soft, and in its dry state too tough, to be worked by any agricultural implements or machinery yet invented.”11 At Sherman Island, the first of the peat islands to be reclaimed, “as soon as the land got dry enough after the completion of the first levee nearly all owners commenced burning and seeding.”12 Little labor was required, but the peat might smolder for weeks.13

The tule, deprived of water, dies, and one man with a box of matches clears twenty acres per day, not only burning off the tule but the tussocks or roots, the ground being allowed to dry to that condition that permits from six to twelve inches of the upper surface of soft, dead tule roots

12. Tucker, Tucker’s Field Notes, No. 93, 32.
13. Ibid., 2; “The Tules,” Antioch Ledger, May 23, 1874; and “Points on Tule Working,” Pacific Rural Press (Sept. 15, 1877); 169.
The sod was burned by igniting it in a large number of spots. In 1878, one farmer reported digging holes with his boots “every few feet” and igniting them after pouring in kerosene.

Ordinarily, fire-plowing produced a bed of ashes that extended to depths from six to twenty-four inches. The largest value was consistent with measurements made in 1922 on virgin land at Mildred Island. The resulting early seedbeds were like an old garden in their “mellowness.” Into the seedbeds workers broadcast wheat or barley, commonly with a coffee-mill sower, which was covered by a brush harrow or trampled into the damp peat by sheep.

At the Webb Tract, bands of two hundred to three hundred sheep were used in 1871. On Bacon and Mandeville Islands in 1872, bands of seven hundred to one thousand head trampled about twenty to thirty acres per day per band. Such bands worked about seven or eight hours per day, conducted systematically over the seeded area by a man who led the bellwether, followed by five or six drivers who kept the stock together.

Alternately, a large two-man rake could be drawn through the ash, followed by a plank dragged along the ground to compress the ash and reduce loss from wind. Another mode of preparation was to stock the land so heavily with cattle, sheep, or swine that the native vegetation would not recover.

Before 1875, fire-plowing and the “sheeping-in” of grain and hay crops occurred variously in areas of several hundred to between four thousand and nine thousand acres at Sherman, Twitchell, Lower Brannan, Andrus, Middle Andrus, Bouldin, Mandeville, Venice, Bacon, and Grand Islands; the Webb Tract; and to the west of the westernmost distributary channel of the San Joaquin River. In sum, by 1877, more than thirty thousand acres of tule land had been broken and cropped. Such land yielded wheat harvests averaging thirty to forty bushels per acre, and as high as seventy to eighty. Compared to the sixteen bushel average yield for the state (1879), the Delta’s was a bonanza. Barley, too, was remarkably productive.

Fire-plowing had serious limitations. Peat fires were difficult to extinguish, persisting sometimes until the rains of winter soaked the land. Meanwhile, uneven spread and penetration by fire resulted in surface irregularities that later hampered irrigation and drainage, as well as the operation of wheeled machinery. However, the most serious consequence for cropland derived from tidal wetlands was the loss of surface elevation.\textsuperscript{19}

Croplands derived from tidal wetlands were low enough in their original state, and a reduction of from one to four feet effected a radical change in their character. From dry ground they were too frequently converted into ponds of water, and for long periods were unfit for cultivation.\textsuperscript{20}

It appears that burning the surficial peat transformed three and a half to four inches of sod into one inch of ash and dust. “From a comparison of the burnt and unburnt ground it was evident that the roots and vegetable matter are burnt to a depth of seven or eight inches, as the burnt surface was everywhere at least five or six inches below the natural sod alongside of it.”\textsuperscript{21} S. W. Cosby noted years later that six inches of the deeper peat reduced to one inch of ash and dust.\textsuperscript{22} At least on Sherman Island, a problem with alkaline conditions was noted on burned land in 1874.\textsuperscript{23}

After 1875, it was common practice on lands with soils of higher alluvium content to remove the vegetative cover by burning. The task was done while the sod was too damp to ignite. Sometimes, the tules were flattened with rollers.

Land developers of the late 1870s on Upper Union and Roberts Islands, and on the islands with loamy natural levees adjacent to the Sacramento and Mokelumne Rivers, tended to work the underlying turf of tightly matted tule roots mechanically, rather than burn it. The procedure on Upper Union Island in 1877 involved fifty plow teams of four to six horses and plowshares with unusually sharp cutting edges made for that purpose in Stockton. Workers allowed the upturned clumps of sod to dry prior to breaking them with harrows, after which they proceeded with planting. Similarly, on Roberts Island, plowing proceeded from south to north through the growing season as the soil became drier. Alternatively, the dried sod might be burned or allowed to decompose through the summer before planting. In such cases, cross-plowing and dragging preceded sowing.\textsuperscript{24}

The more common dependence on plows to prepare seedbeds in the organic soils of

\begin{itemize}
    \item \textsuperscript{21} “Our Tule Islands,” \textit{Daily Alta California}, July 25, 1865.
    \item \textsuperscript{23} Ibid., 14; “Our Tule Land,” \textit{Antioch Ledger}, Aug. 1, 1874.
\end{itemize}
Portuguese farmers in the Sacramento Pocket area, 1911. Center for Sacramento History, Portuguese Historical and Cultural Society Collection, 1984/181/072.

Tide gate. Dyer Photograph Album, MSS 229, Holt-Atherton Special Collections, University of the Pacific.
higher alluvium content was understandable. Along the rivers, where alluvial soils pre
dominated, cultivation of the sandy loams extended from the crowns of the natural levees
into the tules. Moreover, the wetlands within the basins were underlain by peat to slight
depth. For instance, in the area from Walnut Grove to Courtland, the bed of peat was
only three or four feet thick (1877). Nevertheless, a soil fire appears to have been tolerated
there.\textsuperscript{25} Regardless of the location, after the peat ashes were gone, “the land depend[ed]
upon its own true merits and improve[de], so far, every succeeding year by cultivation.”\textsuperscript{26}
Once broken, the land required no further burning.

When the second cycle of peat island reclamations was effected with the massive
dredge-built levees typical of the first two decades of the twentieth century, the practice
of burning the tule cover in the fall appears to have been fairly common.\textsuperscript{27} The cutting of
drainage ditches and installation of pumps followed. When the material was dry and firm,
workers used power machinery to plow and disc the soil into desired seedbed consisten
cies. The plowing turned up tule roots and underlying “buckskin”-colored peat to a depth
of about two feet.\textsuperscript{28}

\textbf{Accidental Fires}

From the 1870s onward, various accounts describe accidental burning of tules, crops,
stubble, and levees of peat, some ignited by machinery. The fires tended to occur during
land preparation or harvest. Hunters set others.\textsuperscript{29} Sometimes, labor campfires, automo-
biles, and downed power lines ignited the peat.

Peat fires could burn for protracted periods. “They are likely to punk along sometimes
for two years under the ground,” reported the \textit{San Francisco Chronicle} in June 1903.\textsuperscript{30} At
Bouldin Island, a fire burned for several months during the summer of 1873, in spite of
attempts to control it. Another fire reportedly persisted for nine months on Lower Union
Island in 1886. The extent of damage is unknown, but a fire at Roberts Island was report-
ted to have consumed three hundred acres of peat during the first five days of an event
that lasted at least one month in late 1885. Another thousand acres were burnt over the
course of a week in late 1887.\textsuperscript{31}

In November 1880, newspapers reported ground fires that lasted one week, penetrated
the soil about fifteen inches, and consumed more than six to seven hundred acres at
Andrus Island and a large segment of Brannan Island. In 1878, they reported a fire along
the west side of what is currently known as Upper Jones Tract (Map 2) that penetrated

\begin{footnotes}
\item 29. Tucker, \textit{Tucker’s Field Notes}, No. 89, 4, 34.
\end{footnotes}
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the soil up to two feet and took two weeks to creep through 450 feet of levee. In 1910, fire burned 1,457 acres of soil and cropland at Victoria Island before a clamshell dredge cut the levee and admitted water to extinguish the blaze. At various times, newspapers reported ash beds of up to ten feet in depth (1877); and penetrations from fire up to one and one-half feet (1880), two feet (1878), three or four feet (1873), six feet (1873), fifteen feet (1887), and twenty feet (1899 and 1903).

Grain and stubble fires on tracts of peat are known to have happened as early as 1875 on Sherman Island, where they destroyed several hundred acres and burned several people. However, the incidence of accidents like this appears to have peaked in the late 1890s, when the use of coal- and straw-fired traction engines and harvesters became common. The machinery had spark arrestors, but they were imperfect. The risks of using such fuels enhanced the attractiveness of converting boilers to burn petroleum. Fires might also result from overheated machinery or the grounding of the firebox of a traction engine as it broke through the crust of the soil.

Grain or stubble and related soil fires attributed to ignition by machinery occurred at Union and Roberts Islands, the Palm and Byron Tracts, the southern and southwestern fringe of the delta of the San Joaquin River, and at Brannan and Ryer Islands, near Rio Vista. Data on the extent of damage are fragmentary, but aggregate losses in a peat and grain fire at Union Island in 1899 were measured at 926 acres. Losses of between 75 and 100 acres were likely at Ryer Island in 1899, and at the Palm Tract in 1905. Fire destroyed 27,000 dollars worth of sacked barley (the equivalent of about 900 acres) on Victoria Island in July 1904. Perhaps 18 acres of stubble and surficial soil were lost at Brannan Island in 1910. More serious that year was an estimated 35,000-dollar loss of 1,690 acres of barley on Union Island.

Although grain and stubble fires might not engulf most of an island or tract at any one time, they were extensive enough to break tenant farmers. Newspapers reported losses of twenty-six horses and a header, a horse and wagon, and a contractor’s harvester and traction engine. More frequent were soil fires started by careless ignition of straw at threshing sites. Sometimes, bailing averted the risk.

Fires ignited by automobiles or fallen power lines also occurred at times. In 1915, the ignition of gasoline leaking onto a muffler at the Byron Tract led to the explosion of an automobile’s gasoline tank, the ignition of stubble and soil, and the destruction of frame structures in a work camp, all of which resulted in about twenty-five thousand dollars worth of property damage. A clamshell dredge quenched the fire by cutting a levee, which flooded five hundred acres.36

In late 1919, a fire that began at a laborer’s camp on Byron Tract swept parts of the Byron and Veale Tracts and Victoria Island. It burned two other camps, the Old River Bridge of the Borden Highway (State Highway 4), and a bridge near the eastern end of Victoria Island, along with a Franklin automobile worth four thousand dollars. On Victoria Island, workers cut the levee to quench the fire, but they relied on siphons at Byron Tract. Losses were estimated at fifty thousand dollars for the fire at Victoria Island, but are unknown for the Byron and Veale Tracts and Old River Bridge.37

In late 1910, a fallen power line started a fire that burned stubble and peat on forty acres of Brannan Island for at least two weeks and required the labors of seventy-five men and a pump to quench.38

The Behavior of Peat Fires and Efforts to Contain Them

The behavior of fire in peat is described in an account written in the middle of 1903:

To one side there is a haze; on nearer approach it shows as a smoke, faint, dim, mounting straight upward and coming from no one point, but seeming to overlie the whole area... And presently you come to the “fire.” Before its slow advance is the black earth, topped with matted, withering tules. Behind it is a light, puffy, pink ash. This ash is feathery in consistency; you can blow away a handful with the merest breath... Once fairly started such a fire will burn all summer, consuming very slowly all the peat soil, though it lie twenty feet deep. The rains of winter finish it; they also wet down and pack the ash, and then the farmer comes and cultivates his tract just as though it had not been burned. Some of the most fertile tracts in the islands have been through the furnace.39

One very dangerous aspect of the spread of fire through lands underlain by peat was the tendency for surfaces to appear safe to cross when actually the weight of animals and vehicles caused them to break through into searing ash. Ensuing struggles transformed the site into a “smoldering pit.” One observer claimed in 1899 that one such crust was eighteen inches thick. “There is little doubt that many of the recent field fires were due to

Rolling tule reeds. Floyd Hal Higgins Collection (D-056). Special Collections, University of California, Davis.

Harvesting potatoes in the Sacramento-San Joaquin Delta. San Joaquin County Historical Museum.
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The fire getting through the crust and igniting the grain,” he asserted. The county surveyor, retained by an insurer, measured losses of 158, 200, and 568 acres. As noted above, the burning of a cowboy and his mount in 1873 was attributed to them breaking through such a crust.\textsuperscript{40}

In the early days of peat reclamation, workers contained soil and levee fires by enclosing them with ditches or by wetting down or flooding the area with water delivered by a barged fire engine, a riverboat, or a breached levee. To extinguish a fire in 1878 that destroyed 450 feet of levee at the present Upper Jones Tract, a fire engine barged from Stockton needed to pump water four days. In 1885, workers on Roberts Island attempted to contain a three-hundred-acre fire by ditching to remove the layer of combustible material.\textsuperscript{41}

River steamers were used to extinguish levee fires started at a grain and bean warehouse at Roberts Island (1887), at a site about three miles west of New Hope Landing (1896), and at Twitchell Island (1908) that extended almost half a mile from the labor camp where it began. The latter fire ended up consuming a house and barn and penetrating the land and levee.\textsuperscript{42}

In the early days of reclamation, when the floors of peaty islands were relatively high, the efficacy of levee breaching was not as great as one might expect. During periods of low water, a high tide might not sustain enough flow to quench a soil fire on distant land. Later, as the surface of the land subsided, a soil and levee fire might be suppressed by levee breaching with a dredge (1899, 1910, 1915), or by bringing into service (1899) one of the large-capacity floating stream pumping plants used to water newly leveed tracts and to subsequently irrigate. Following such breachings, which were described in 1910 as “a frequent necessity,” the dredge restored the levee.\textsuperscript{43}

Use of Fire in Potato Cropping

The concluding phase to the reclamation of peat lands in the central Delta occurred between 1900 and 1917, when dredges leveed about twenty-five tracts that totaled more than ninety thousand acres. Actually, a number of the tracts had been reclaimed and abandoned prior to 1876, after which they became filled again with tules, willows, and ponded areas. Much of the newly drained land was planted with potatoes, the “ash land” producing the brightest and best shaped tubers.

\textsuperscript{40} Ibid.; “Burnt in the Tules,” Antioch Ledger, Aug. 2, 1873; “The Exact Loss,” Stockton Daily Record, July 29, 1899; and “Union Island is a Warm Locality,” Stockton Daily Record, July 28, 1894.


Although such peat land might produce satisfactory potato crops for three successive seasons, a fungal problem required the adoption of an “ordinary rotation” (1910), which involved beans, onions, and barley, before workers planted potatoes again the fifth year. It was not uncommon by the 1920s for them to plant potato crops in alternate years, or to cultivate crops in succession, after which they raised small grain for one to several years. Before the workers returned to potatoes, they burned, soaked, and drained the upper three to five inches of soil, then plowed so that the ash was buried about twelve inches. After overwintering, they worked the land to the consistency of a flower bed. Such burning liberated the potash and was believed to reduce the incidence of plant pests and diseases, as well as weeds.44

Whatever the awareness among landowners and tenants of the long-term effect of periodic soil burning at any one tract, periodic firing of the upper three to five inches of soil remained a common practice into the 1950s. Such burnings normally occurred once every five to ten years, but the frequency increased during World War II because of the profitability of potatoes and sugar beet crops. During such burns, water levels maintained by sub-irrigation from a dense network of ditches controlled the penetration and quenching of fire. Nevertheless, fire was known to escape into adjacent lands “with great destruction.”45

Considering that thirty to fifty thousand acres of potatoes were planted each year between 1910 and 1920, and assuming that the land was burned one to four times after the initial clearing, fire consumed a substantial volume of peat. Perhaps 3,000 to 8,750 acres of peat were burned to a depth of three to five inches each year. The extent of potato crop plantings subsequently declined. Since the 1950s, the number of acres planted each year with potatoes, mostly at Bacon Island and McDonald Tract, has probably not exceeded 2,500 acres by much. Assuming earlier rates of burning, it may be that about 250 to 500 acres are currently burned each year. In any case, as late as 1980 “significant burning of organic soils [was] taking place.”46

Conclusion

Modern investigators have estimated that at least three inches of subsidence occurred each year across the floors of seventeen peaty islands and tracts in the Sacramento-San Joaquin Delta between 1911 and 1952. They attribute such loss of elevation primarily to oxidation, followed by shrinkage and wind erosion, and they see localized burning contributing only to a minor extent.

These findings seem to warrant reassessment, although the average rate of subsidence and the principal current causes are consistent with findings of recent research in the field.

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and are appropriate in making projections about the future of the peaty islands.47

The use of fire to transform virgin peat into seedbeds was a common practice from the inception of reclamation in the central Delta until about 1920. Once broken, the organic soils did not require subsequent burning. From about 1900 to 1920, several thousand acres of peat were burned each year as part of routine soil management whenever potatoes were planted on a recurring basis. Such intentional burning of the top three to five inches of soil continued, although the amount of acreage involved declined from the peak years and from the lesser peaks of World War II.

Whatever the precise nature of subsidence as a process prior to the initiation of field research on this issue in the 1920s, it involved fire as a causative agent to a degree to which modern investigators have not previously documented.

47. Ibid., 1, 5, A1-A4.


Illustrated History of San Joaquin County, California. Chicago: Lewis, 1890.


Tucker, E. E. *Tucker's Field Notes on Reclamation*. [Sacramento, 1934].


About the Author

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