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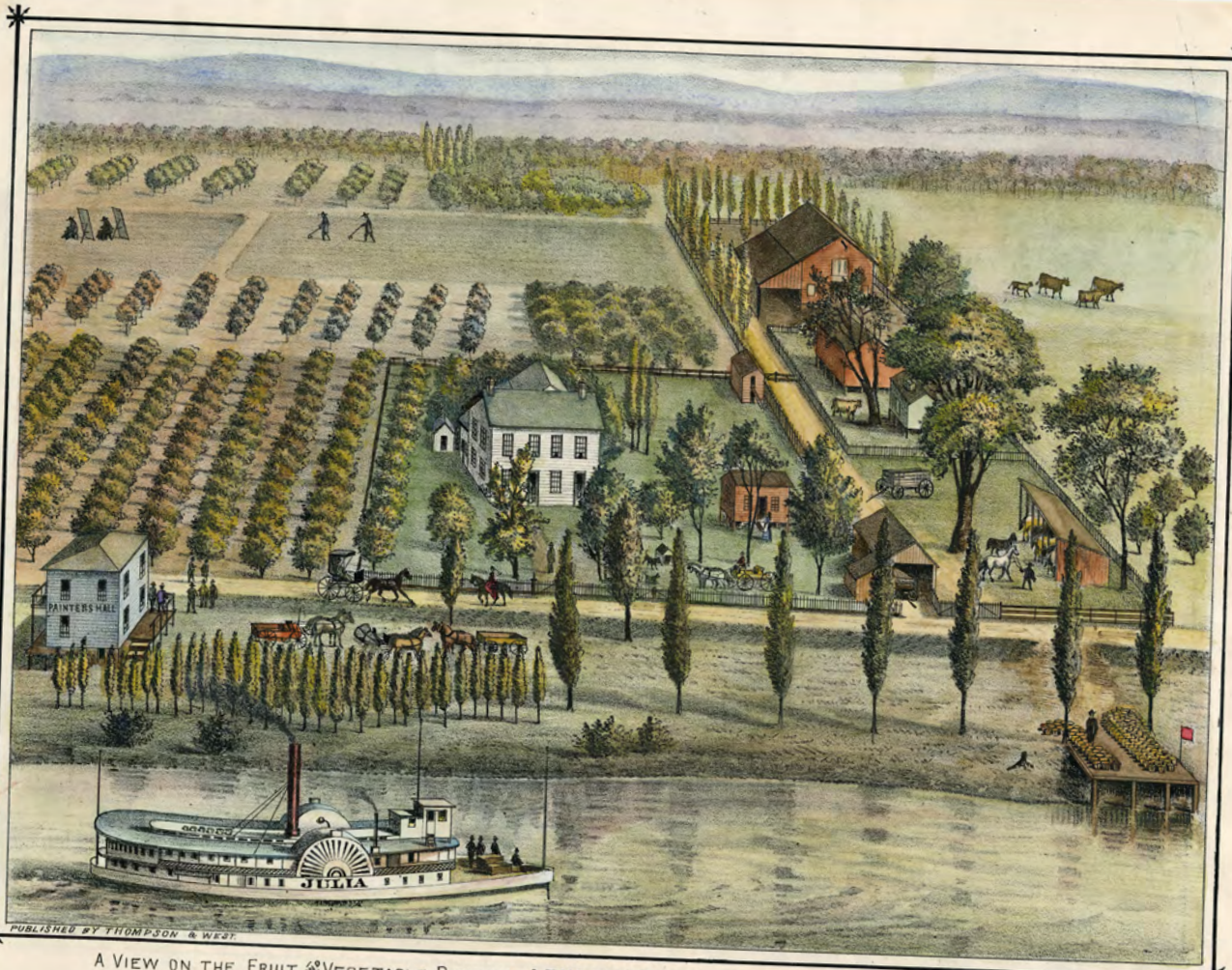
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Steamboat Julia on the Sacramento River, 1880 (California State Library).

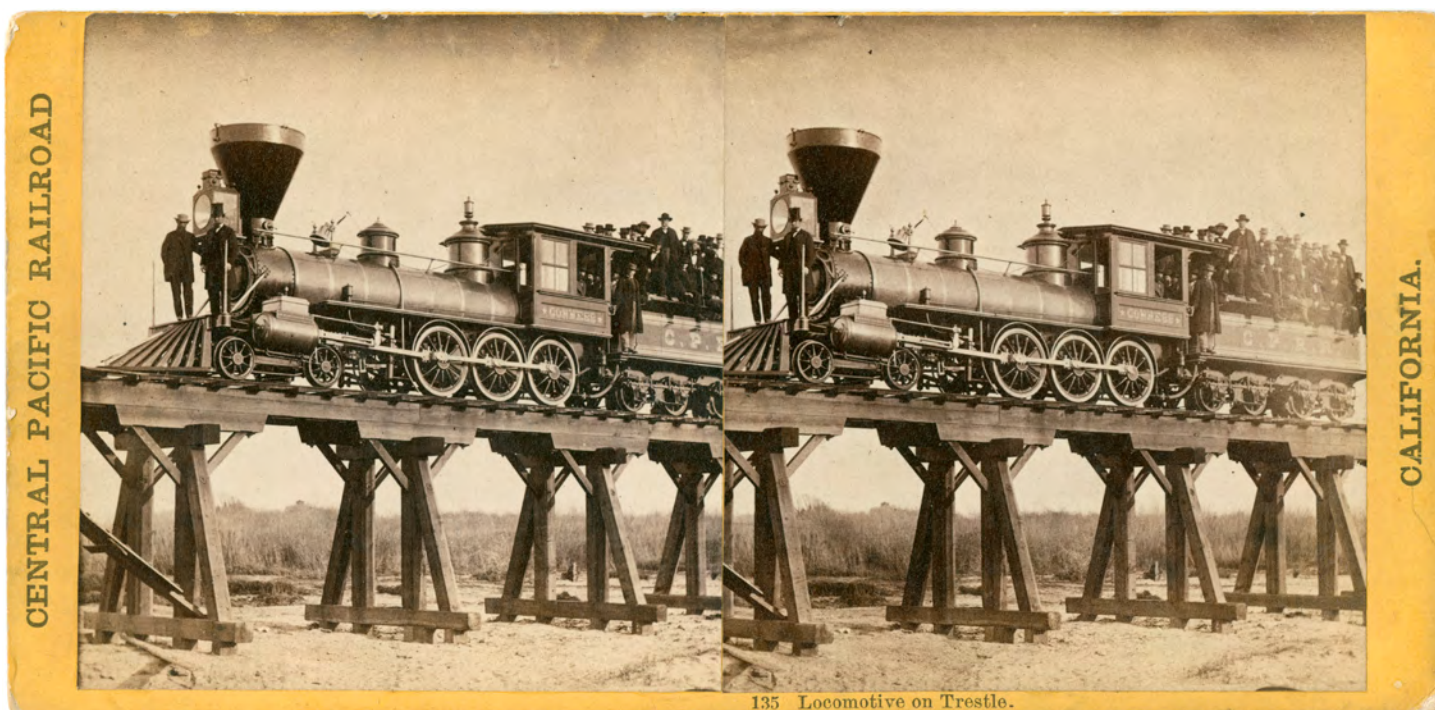
Transportation Revolutions in California(II):

The Age of Steam

By Francisco Céntola, Georgetown University*

Francisco Céntola is a PhD student in the History Department at Georgetown University. This contribution is the second of a series of articles dealing with the major transportation revolutions that took place in California between the late eighteenth and early twentieth centuries.

During the late 1840s, two relatively short processes reshaped the history of California. The first one was the war of 1846-1848 between Mexico and the United States, which resulted in a massive transfer of land and natural resources from the former to the latter.¹ Alta California, a Mexican territory since 1821, was part of the cession defined by the treaty of Guadalupe Hidalgo on February 2, 1848. The second transformative development began less than two weeks before the signing of that agreement and lasted for several years. It involved the large-scale discovery of alluvial deposits of gold in the Sierra Nevada foothills and an unprecedented influx of migrants who, seduced by the prospect of overnight wealth, came in large numbers from various parts of the globe.² These sequential milestones interlocked California's historical trajectory with that of the United States, one of the few nations in the world then undergoing rapid industrialization.³



Locomotive, Central Pacific Railroad, 1863 (California State Library, gift of Mead B. Kibbey).

Of all the profound rearrangements brought about by the industrial shift in California and elsewhere, perhaps the single most important one was the emergence of a new energy system based on two critical elements: steam power and coal. Steam engines, which can be described conceptually as inanimate prime movers, were the first practical devices capable of generating controlled mechanical power by burning different substances.⁴ Although firewood was widely employed during the nineteenth century to drive these machines, coal soon became the dominant industrial fuel on a global scale. The availability of

vast pools of fossil matter stored below the ground gave rise to a distinctive energy regime that, with some variations, persists until the present day.⁵

One of the most spectacular changes derived from the adoption of steam took place in the sphere of transportation. At least three reasons can explain why, starting in the early nineteenth century, the conversion of heat into motion became a central tenet of human mobility. First, steam engines offered new degrees of autonomy from both endogenous and exogenous factors vis-à-vis pre-existing alternatives. This technology was obviously not devoid of limita-

tions, including potential mechanical failures and dwindling fuel supplies, but as a rule steam power was more steady and reliable than human or animal power (which are a function of the naturally restricted capacity of biological converters) and wind power (which is subject to atmospheric fluctuations in intensity and direction).⁶ The possibility of stocking and burning fuel at will without sizable interruptions became crucial to reduce travel times. Second, steam engines had a much higher maximum power as individual prime movers. This feature is essential to understand their significance because an equiva-

lent output could not be obtained simply by combining multiple smaller power units—only so many sails can be hung on a ship's mast and so many horses can pull a wheeled vehicle.⁷ The gap in terms of maximum power controlled by one person was particularly drastic in the case of land transportation, with a nearly 80-fold rise between mid-eighteenth-century four-horse coaches (about 2,600 watts) and mid-nineteenth-century locomotives (more than 200,000 watts).⁸ Third, steam-powered transportation was not only practical but also increasingly cost-effective, in part due to the systematic exploitation of relatively cheap fuel resources—wood and especially coal—throughout the world.

California experienced a transportation revolution of its own during the second half of the nineteenth century. Short- and long-distance railroad lines multiplied across the state, as did ocean, coastal, river, bay, and lake steamers. This process was part of a local industrial turn that, unlike its British and eastern American counterparts, depended mainly on the intensive exploitation of natural resources rather than on factory production.⁹ Great quantities of minerals, lumber, and agricultural products were channeled through the new transportation network, which became a true logistical backbone for these extractive sectors. Steamships and railroads also boosted the ongoing process of urban growth, shaped settlement patterns, and prompted the exploitation of previously isolated areas by enhancing access to regional, national, and global markets.

After some decades of experimental development, the first commercially viable steamboats appeared at the beginning of the nineteenth century in North America and Europe.¹⁰ This new technology achieved rapid success, especially along interior waterways, thanks



China steamer coming into San Francisco, Cal.

Steamship, San Francisco Bay, 1877 (California State Library).

to an unrivaled combination of speed, tonnage, and comfort. Besides, steamers were able to cut upstream traveling times significantly: the journey from New Orleans to Pittsburgh up the Mississippi and Ohio rivers, for instance, took four months or more by keelboat and only 15-20 days by steamboat.¹¹ Steam power gradually expanded across many of the largest river systems of the planet, including the Amazon, Ganges, Niger, Tigris-Euphrates, Volga, and Yangtze, as well as in estuaries, lakes, and canals.¹²

Oceangoing steamships also had an enormous global impact, but their definitive triumph over sailing craft was not straightforward. The shift from sail to steam began during the first half of the nineteenth century, mainly on short routes of the North Atlantic where speed and predictability were valuable (e.g., the

movement of passengers across the Irish Sea or the British Post Office coastal services).¹³ By 1865, steamers had partially conquered various sea lanes of up to c. 3,000 nautical miles.¹⁴ The opening of the Suez Canal in 1869 was a key turning point because only steamships benefited from this maritime shortcut between Europe and Asia: due to inadequate wind conditions in the Red Sea and the high cost of being towed through the canal, sailing vessels continued making the longer journey around the Cape of Good Hope.¹⁵ Although steam power gained momentum during the 1870s and 1880s, in some regions like Australasia, northern Europe, and the western Americas sailing ships retained a footing past the turn of the twentieth century.¹⁶

The rise of steam technology on California's inland waters began in late 1847,



when a small launch formerly owned by the Russian American Company chugged through San Francisco Bay for the first time.¹⁷ Most of the machinery and technical knowledge initially came from the eastern United States, where this mode of transportation had been employed for decades, but over time a local shipbuilding industry developed on the West Coast.¹⁸ Steamboats flourished along the state's main fluvial artery, formed by the Sacramento and San Joaquin rivers, their delta, and San Francisco Bay, as well as on the Colorado River and other bodies of water like Humboldt Bay or Lake Tahoe. According to Jerry MacMullen, about 400 river steamers and ferries were active across California between the mid-nineteenth and early twentieth centuries.¹⁹

Ocean and coastal steamships created

a parallel revolution at sea. Thanks to various innovations in design and construction, including the adoption of compound and triple expansion engines, larger iron/steel hulls, and screw propellers, the efficiency of these vessels improved substantially during the second half of the nineteenth century.²⁰ However, the trade of goods with low value-to-weight ratios across long distances and the scarcity of coaling stations in the northern Pacific worked to the advantage of sailing craft and delayed their extinction.²¹ California's "grain fleet," which carried wheat, barley, and flour mainly from San Francisco to Liverpool around Cape Horn, is a paradigmatic example of the persistence of sail during the era of steam.²² Sailing vessels remained competitive in some bulk trades even as late as 1900, but throughout the following few decades steamships finally

displaced them and became the dominant form of oceanic transportation.²³

Motored craft reconfigured the circulation of people, goods, information, and pathogens in California. During the Gold Rush, for example, steamers played an instrumental part in routing thousands of Argonauts from Panama to San Francisco, and from there to various towns that served as gateways to the southern and northern mining regions.²⁴ In addition to handling passenger flows, river steamboats conveyed all sorts of goods necessary to sustain the state's burgeoning population and, later on, became essential to move grain and flour from the Central Valley to the Bay Area.²⁵ At the same time, ocean liners channeled increasingly large amounts of outward and inward cargo, strengthening California's commercial links with various Pacific markets and with the Atlantic world via Panama.²⁶ Steamers also carried mail across the sea and along local rivers, as well as potentially lethal germs: it is likely, for instance, that the arrival of bubonic plague in San Francisco at the beginning of the 20th century was facilitated by vessels of this type.²⁷

Like other branches of the industrial turn, steam navigation left enduring marks on the ecosystems of California. In the Sacramento, San Joaquin, and Colorado rivers, the sustained use of biomass as steamboat fuel (e.g., oak, ash, willow, or cottonwood) contributed to the depletion of riparian forests.²⁸ A great number of invasive species were introduced via ship fouling or ballast water, rocks, and sediments, such as brass buttons (*Cotula coronopifolia*, reported for the first time in the San Francisco peninsula in 1878) or Australian tubeworms (*Ficopomatus enigmaticus*, reported for the first time in Lake Merritt, Oakland, in 1921).²⁹ Besides, ports, dockyards, and other forms of shipping infrastructure generated both physical alterations and chemical pollution in near-shore environments.³⁰