

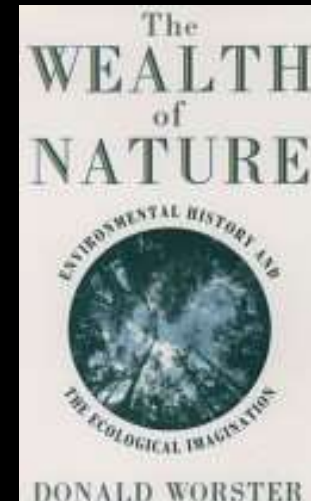
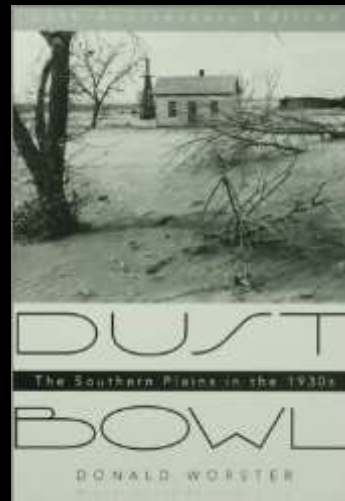
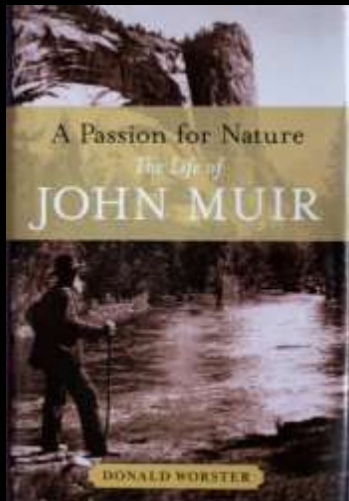
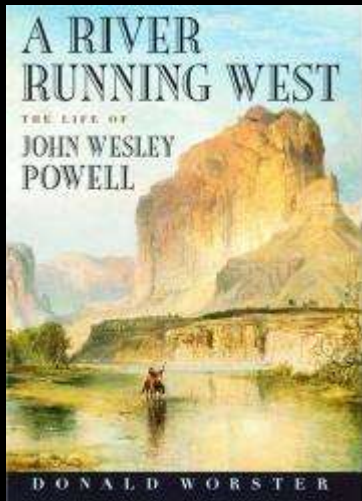
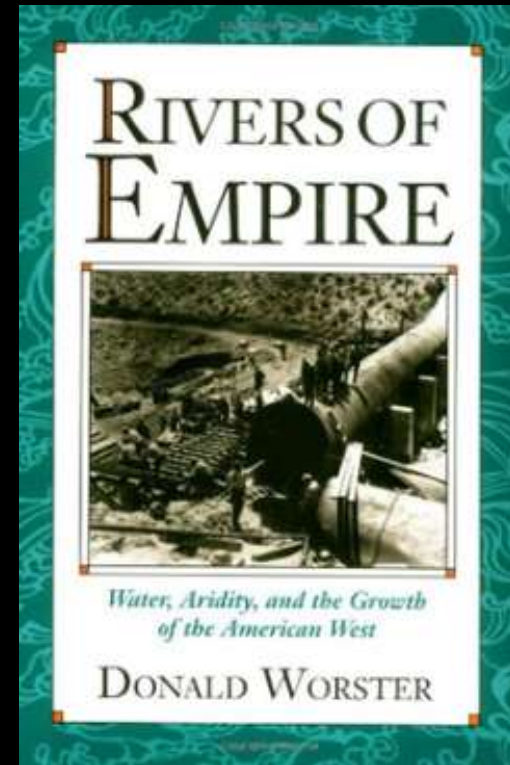


## Rivers of Empire: American Environmental History and Waterways

Kevin M. Anderson, Ph.D.  
Austin Water – Center for Environmental Research



# American Environmental History and Waterways



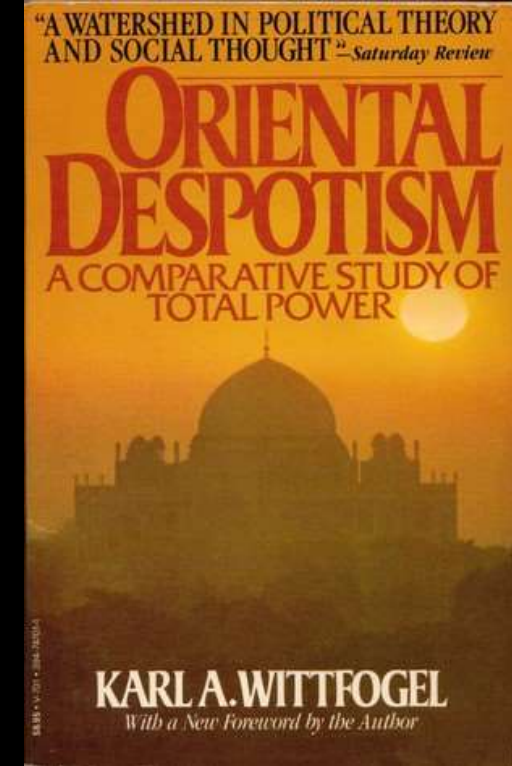
# Hydraulic Empire and Karl Wittfogel

- A social or government structure which maintains power and control through exclusive control over access to water.
- It arises through the need for flood control and irrigation, which requires central coordination and a specialized bureaucracy.
- A developed hydraulic civilization maintains control over its population by means of controlling the supply of water.
- The term was coined by the German-American historian Karl Wittfogel (1896–1988), in his book *Oriental Despotism: A Comparative Study of Total Power* (1957).

He argued that most of the first civilizations in history, such as Ancient Egypt, Mesopotamia, China, Sri Lanka, and Pre-Columbian Mexico and Peru have been hydraulic empires. Wittfogel asserted that such "hydraulic civilizations" are essentially different from those of the Western world.

Theory Disproven?

Archeological evidence now shows that in at least three of the areas that Wittfogel cites as exemplifying his "hydraulic hypothesis" — Mesopotamia, China, and Mexico - full-fledged states developed well before large-scale irrigation.



# Hydraulic Empire?



# The Geography of American Rivers

## Waterways and Ancient Empires



NATIONAL BESTSELLER

"Masterful... A sweeping portrait of human life in the Americas before the arrival of Columbus... A remarkably engaging writer."  
—The New York Times Book Review

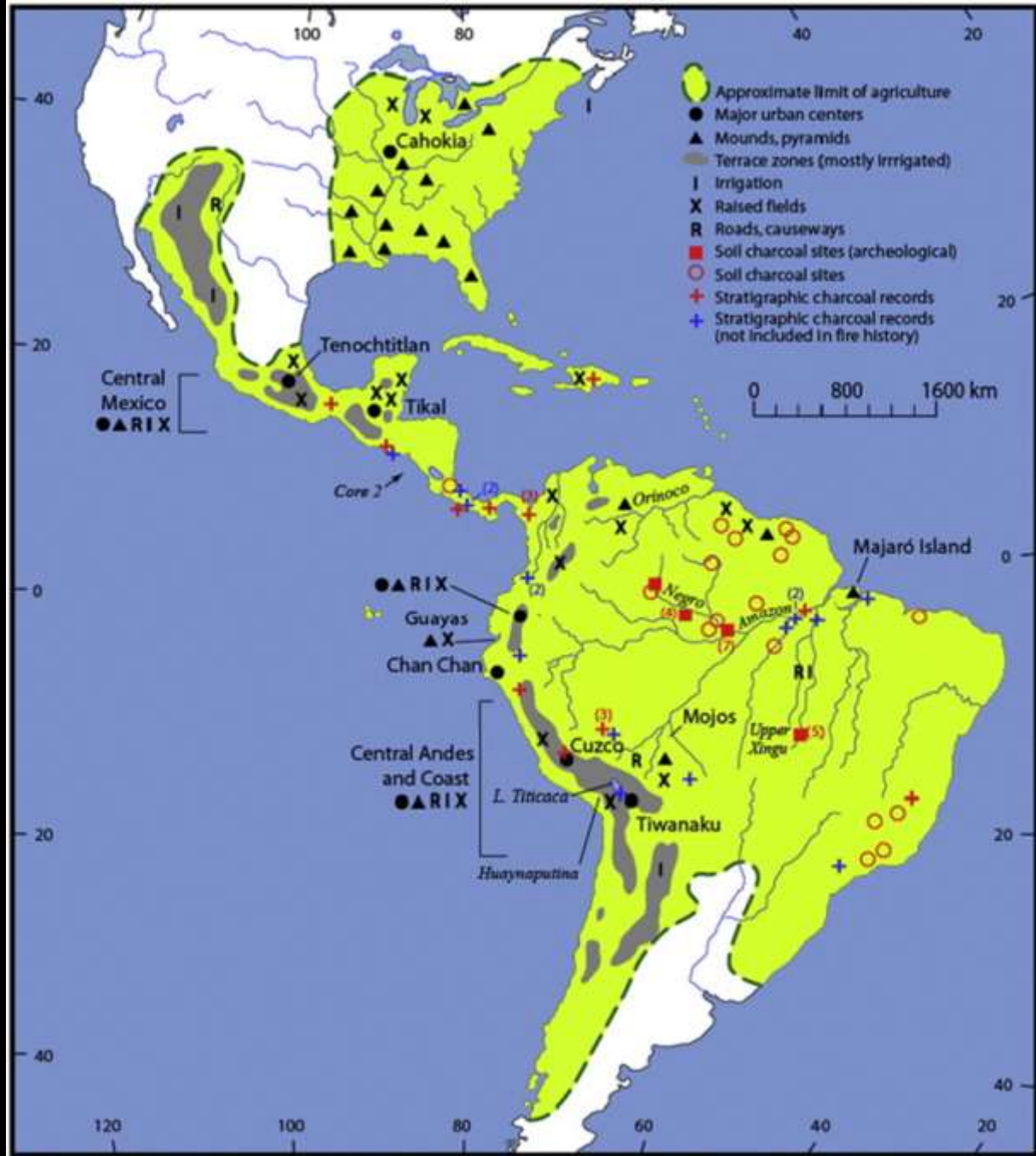
# 1491

NEW REVELATIONS OF THE AMERICAS BEFORE COLUMBUS



CHARLES C. MANN

WITH 6 NEW ILLUSTRATIONS



# 1493

UNCOVERING THE NEW WORLD COLUMBUS CREATED



CHARLES C. MANN

Author of 1491

Americas 1491 "humanized landscapes"

# American Hydraulic Empire

## The Mississippian Culture



# The Ancient North American Humanized Landscape “The Mound Builders”

Beginning with the construction of Watson Brake about 3400 B.C. in present-day Louisiana, nomadic indigenous peoples started building earthwork mounds in North America nearly 1000 years before the pyramids were constructed in Egypt.

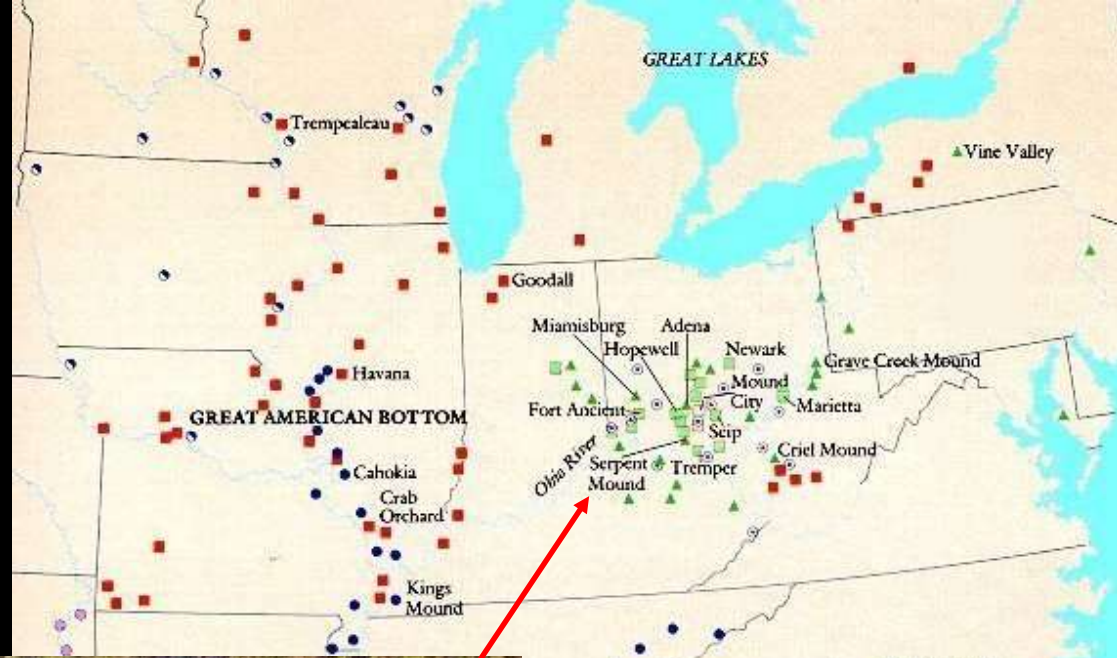


M. O. Riddle  
Adapted from: "Mound Builders & Cliff Dwellers"  
East-Central Time-Life Books: USA 1992, page 11



# The Ancient North American Humanized Landscape "The Mound Builders"

Serpent Mound in southern Ohio is a 1,348-foot mound. It is an effigy mound (a mound in the shape of an animal) representing a snake with a curled tail. Built between 300 BC and 1000 AD.



# American Hydraulic Empire

The Mississippian Culture reached its climax about 1200 A.D.





## Cahokia – The Center of the Mississippian Culture

Located near present day St. Louis, Cahokia was the great city of the Mississippian Culture where groupings of pyramids and burial mounds cover five square miles.

Cahokia's population at its peak in the 1200s, and its ancient population would not be surpassed by any city in the United States until about the year 1800.

In 1200, its population was about 15,000, comparable to that of London or Paris during the same period.

# Cahokia

“Anyone who traveled up the Mississippi in 1100 A.D. would have seen it looming in the distance: a four-level earthen mound bigger than the Great Pyramid of Giza...

Cahokia was a busy port...Covering five square miles and housing at least fifteen thousand people. Cahokia was the biggest concentration of people north of the Rio Grande until the eighteenth century.” Mann, 1491

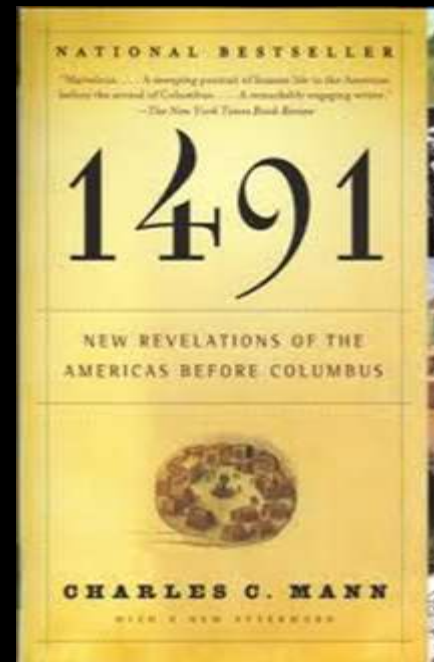


# Decline and Disappearance 1300 AD

Cahokia began to decline after 1300 AD. It was abandoned more than a century before Europeans arrived in North America. Scholars have proposed environmental factors, such as over-hunting, drought, and deforestation as explanations.

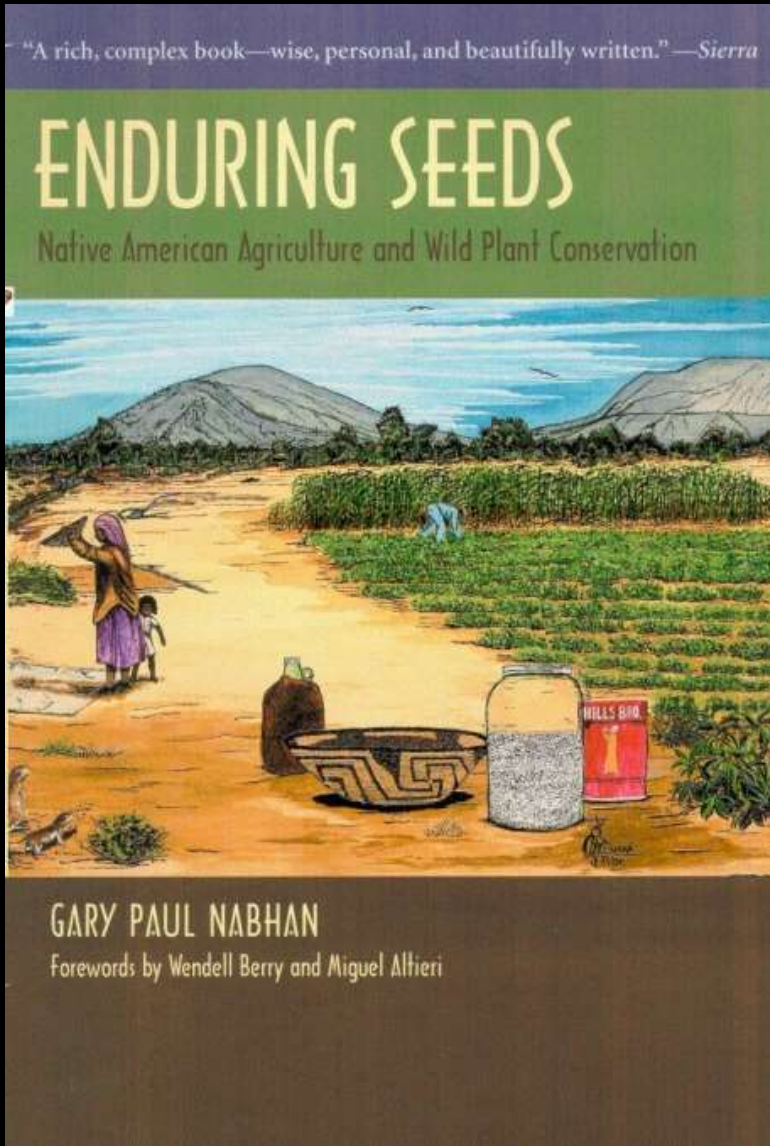
“To obtain fuel and construction material and to grow food, they cleared trees and vegetation from the bluffs to the east and planted every inch of arable land. Because the city’s numbers kept increasing, the forest could not return. Instead people kept moving further out to get timber, which then had to be carried considerable distances...Meanwhile...the city began to outstrip its water supply...”

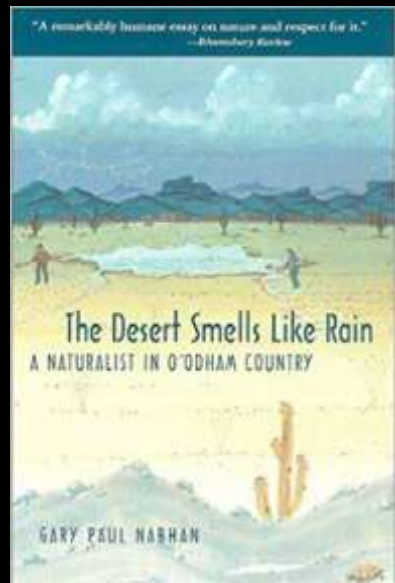
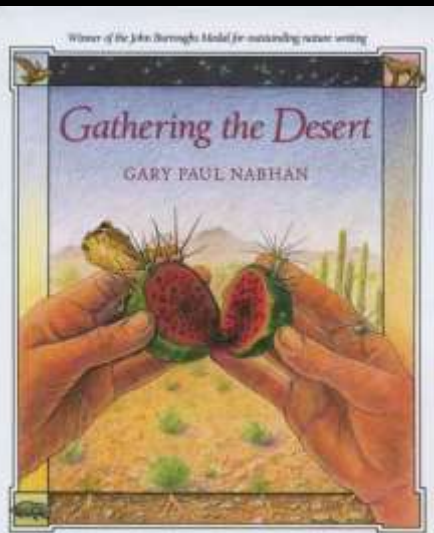
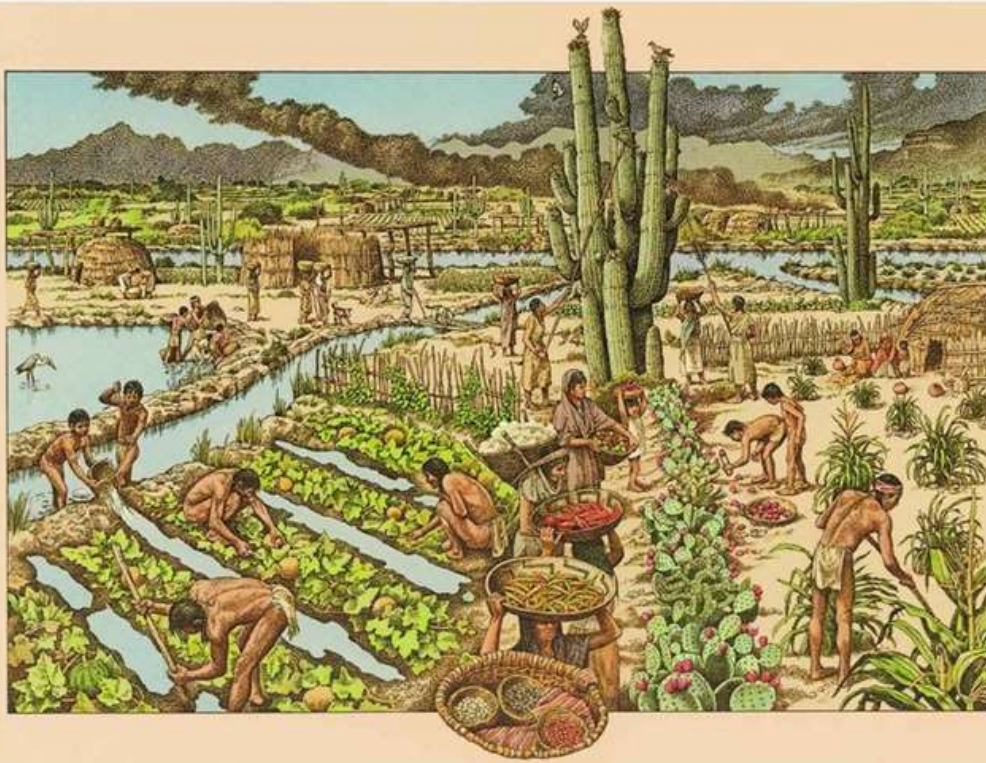
Mann, 1491



# Western Humanized Landscapes

## Irrigation and Dry Land Farming





# Water, the Anasazi, and Chaco Canyon

Around 600 A.D., the Anasazi of Chaco Canyon and other settlements abandoned hunting and gathering in favor of cultivating crops such as maize (corn). To grow maize, they needed rain, but the area was dry and rain was sporadic. What rain did fall was hoarded and used sparingly and effectively. Evidence of dams, canals, and other water control features found by archaeologists shows the importance of water to the Anasazi.

The Anasazi culture of the southwestern United States reached its zenith between 1050 and 1125 A.D. before experiencing a dramatic collapse.

From the twelfth to the thirteenth centuries, many of the pueblos were abandoned. Why would the Anasazi leave — potentially for good — pueblos it had taken them decades to construct? Scientists have found one possible answer by looking at tree rings (a study called dendrochronology). In the period between A.D. 1125 and 1180, very little rain fell in the region.



Examination of pack rat middens revealed that at the time that Pueblo Bonito was built, Chaco Canyon and the surrounding areas were wooded by trees such as ponderosa pines. Scientists hypothesized that during the time when the pueblo was inhabited, the valley was cleared of almost all of the trees, to provide timber for construction and fuel. This tree removal, combined with a period of drought, led the water table in the valley to drop severely, making the land infertile.





GARY PAUL  
NABHAN

\*

Growing  
Food in a  
Hotter,  
Drier Land

\*

*Lessons from  
Desert Farmers  
on Adapting to  
Climate Uncertainty*

\*

Foreword by  
Bill McKibben



Native Seeds/SEARCH (NS/S) is a nonprofit seed conservation organization based in Tucson, Arizona. Its mission is to conserve and promote the arid-adapted crop diversity of the Southwest in support of sustainable farming and food security.

# The Atlantic and Great Lakes – Discovery, Imagination, and Empire



# Fluvial Discovery of America

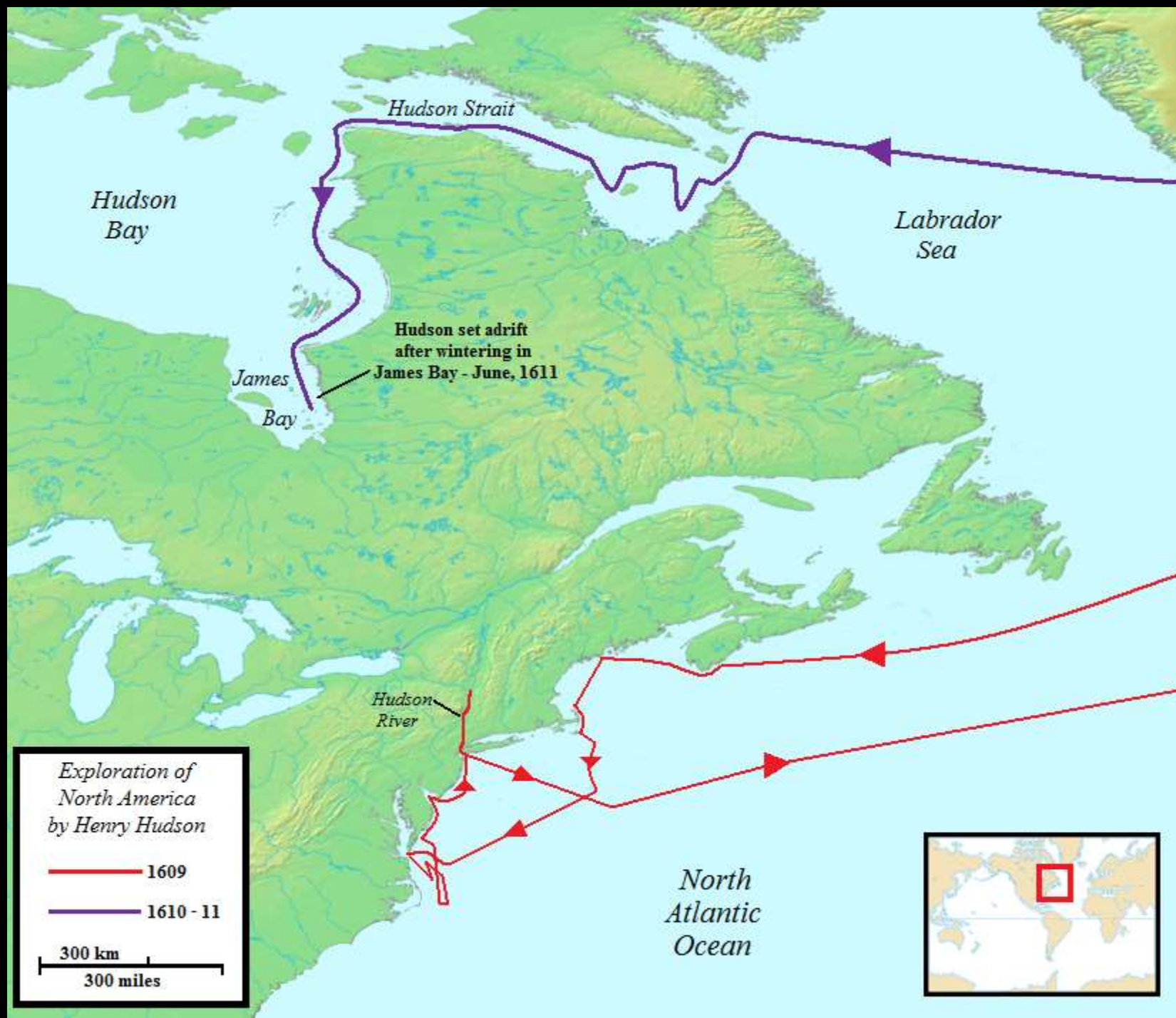
“Another River”

W. S. Merwin 1927-2019



The friends have gone home far up the valley of that river into whose estuary the man from England sailed in his own age in time to catch sight of the late forests furring in black the remotest edges of the majestic water always it appeared to me that he arrived just as an evening was beginning and toward the end of summer when the converging surface lay as a single vast mirror gazing upward into the pearl light that was already stained with the first saffron of sunset on which the high wavering trails of migrant birds flowed southward as though there were no end to them the wind had dropped and the tide and the current for a moment seemed to hang still in balance and the creaking and knocking of wood stopped all at once and the known voices died away and the smells and rocking and starvation of the voyage had become a sleep behind them as they lay becalmed on the reflection of their Half Moon while the sky blazed and then the tide lifted them up the dark passage they had no name for







NEW FRANCE

NEW HAMPSHIRE (1679)

MAINE (part of Mass.)

Portland (1632)

Concord (1727)

Kennebunk (1629)

Portsmouth (1624)

ATLANTIC OCEAN

Deerfield (1669)

Ipswich (1633)

MASS. BAY (1630)

Worcester (1713)

Salem (1626)

Boston (1630)

Northampton (1654)

Springfield (1636)

Plymouth (1620)

Barnstable (1639)

Windsor (1635)

Providence (1636)

PLYMOUTH (1620)

Hartford (1635)

CONN. (1636)

R.I. (1635)

Middletown (1650)

New Haven (1638)

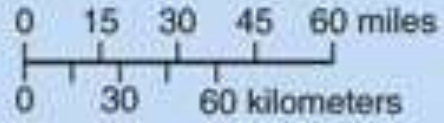
New London (1646)

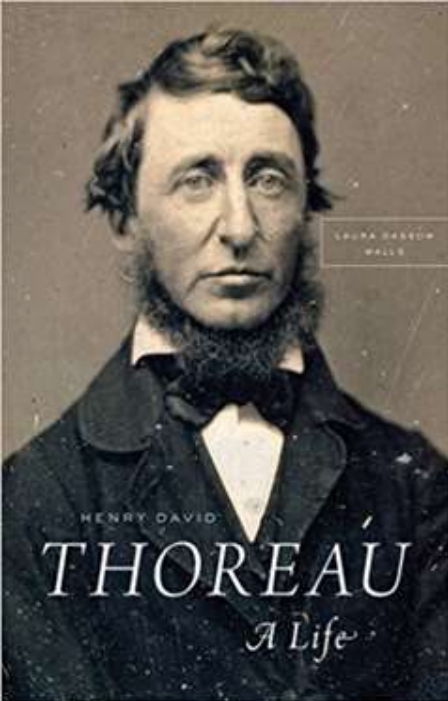
Newport (1639)

NEW YORK

Long Island

Narragansett Bay





## Henry David Thoreau

1817-1862

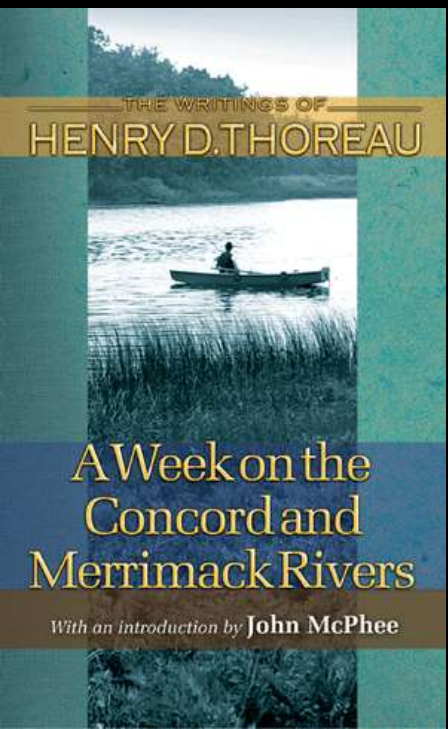
Published 1849

(Walden 1854)

A two-week boating and hiking trip that Thoreau and his brother John took through Massachusetts and New Hampshire in 1839. As John had died from tetanus in 1842, Thoreau wrote the book as a tribute to his memory.

"Henry Thoreau was a man of the river. He was born on the river, he loved it, he felt its flow in his veins, and it, as he said, it 'meanderest forever' in the bottom of his dreams."

Thorson, *The Boatman* 2017



# Thoreau and the New England Hydraulic Empire

In 1704, a mill dam was built in Billerica, Massachusetts, on the banks of the Concord River. It was a small dam, but the social ripples it sent intensified over the course of 150 years, especially after 1798, when the mill and its dam were sold to a group of early capitalists, who raised the dam's height because a higher fall meant more power and thus better financial returns.



Henry and John Thoreau skirted the remainder of the Concord River below the Billerica dam, guiding their boat instead into a section of the Middlesex Canal that extended nearly four miles from its confluence with the Concord near the dam, north and west to the Merrimack River.

The Middlesex Canal was a 27-mile waterway that drove the industrialization of the Merrimack Valley for 50 years starting in 1803.

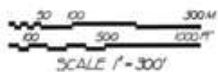
The canal ran from Chelmsford (now Lowell) to Charlestown (now Boston), transforming small agricultural villages into manufacturing towns, even cities. And it cemented Boston's position as the commercial hub of New England.





This was the dawn of the Industrial Revolution in the United States, and the Concord was at its epicenter. Just a few miles downstream, near the confluence of the Concord and Merrimack Rivers, stood the famous Lowell Mill complex, the US first factory system.

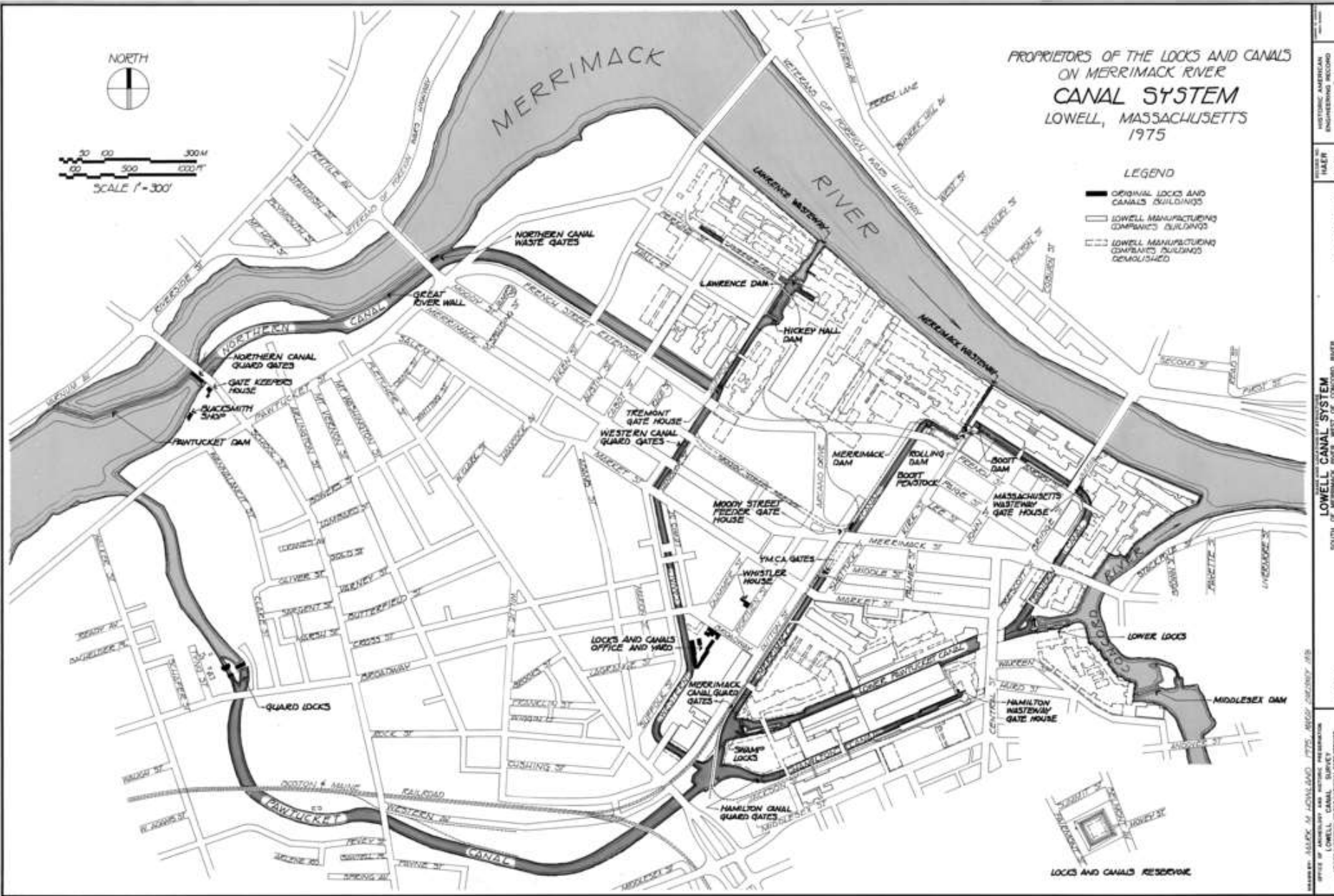




PROPRIETORS OF THE LOCKS AND CANALS  
ON MERRIMACK RIVER  
**CANAL SYSTEM**  
LOWELL, MASSACHUSETTS  
1975

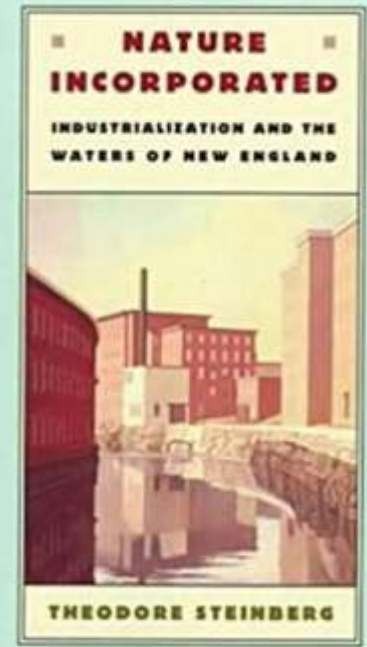
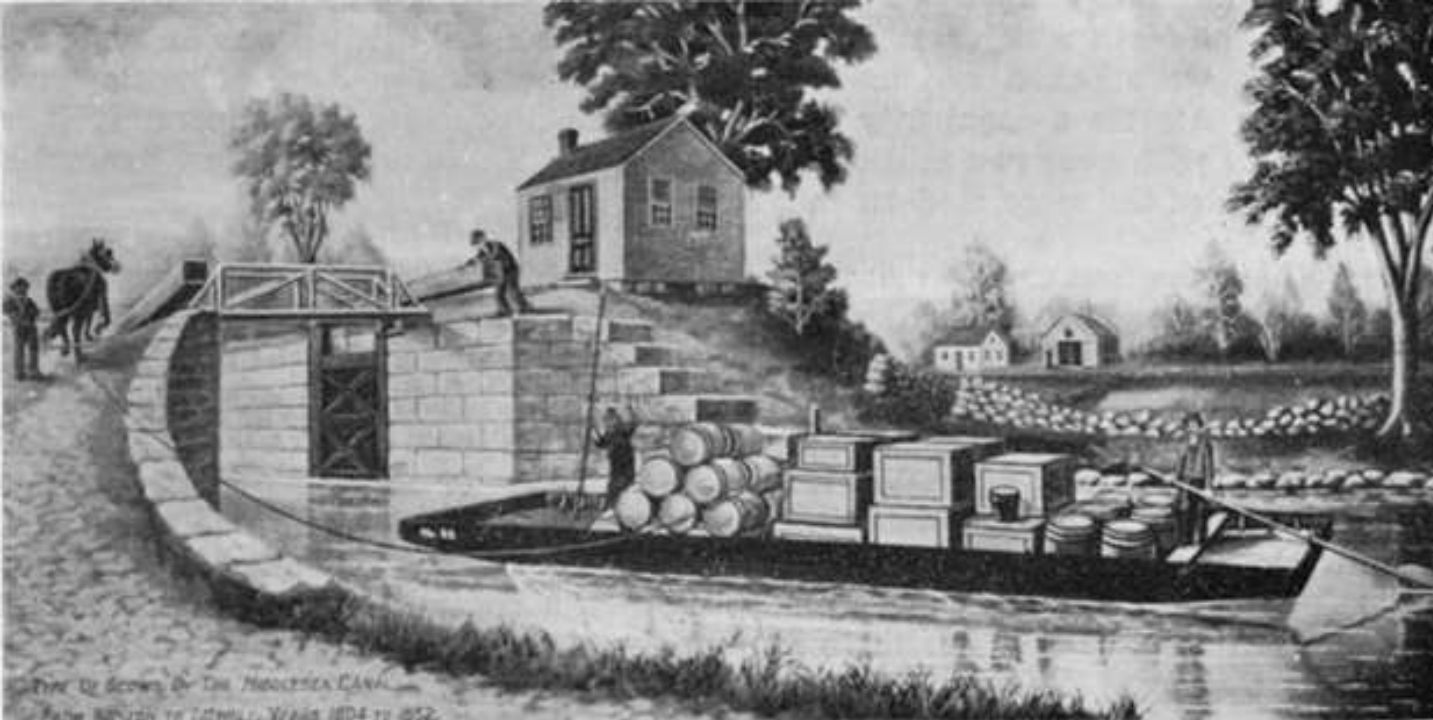
LEGEND

- ORIGINAL LOCKS AND CANALS BUILDINGS
- LOWELL MANUFACTURING COMPANIES BUILDINGS
- LOWELL MANUFACTURING COMPANIES BUILDINGS DEMOLISHED



LOCKS AND CANALS RESERVE

DRAWN BY: MARY ANN LOUIS BIRD, P.E., BIRD, BROWN & BIRD  
 OFFICE OF LOWELL CANAL SURVEY AND RECONSTRUCTION  
 100 STATE STREET, LOWELL, MASSACHUSETTS 01852  
 MAPS BY: MARY ANN LOUIS BIRD, P.E., BIRD, BROWN & BIRD  
 OFFICE OF LOWELL CANAL SURVEY AND RECONSTRUCTION  
 100 STATE STREET, LOWELL, MASSACHUSETTS 01852  
 PHOTOGRAPHY BY: MARY ANN LOUIS BIRD, P.E., BIRD, BROWN & BIRD  
 100 STATE STREET, LOWELL, MASSACHUSETTS 01852  
 LOWELL CANAL SYSTEM  
 SOUTH OF MERRIMACK RIVER  
 MIDDLESEX COUNTY  
 MASSACHUSETTS  
 SHEET 1 OF 2 SHEETS  
 HISTORIC AMERICAN  
 ENGINEERING RECORD  
 MA - 1



“This canal, which is the oldest in the country, and has even an antique look beside the more modern railroad, is fed by the Concord, so that we were still floating on familiar waters. [Yet] it is so much water that the river lets for the advantage of commerce.

There appeared to be some want of harmony in its scenery, since it was not of equal date with the woods and meadows through which it is led, and we missed the conciliatory influence of time on land and water.

But in the lapse of ages, Nature will recover and indemnify herself, and eventually plant fit shrubs and flowers along its borders. Thus all works pass directly out of the hands of the architect [and] into the hands of Nature.”

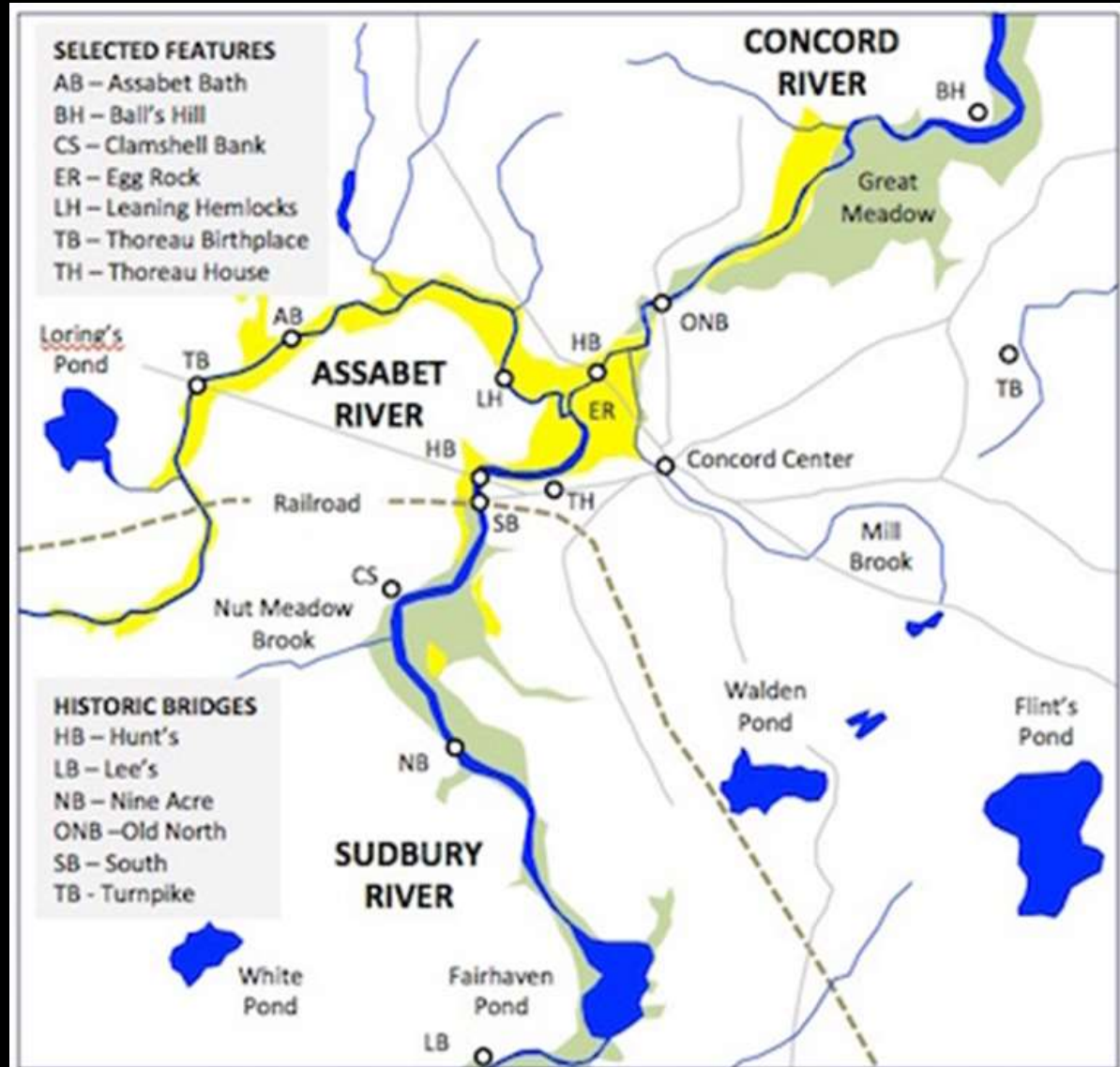
Thoreau, *A Week on the Concord and Merrimack Rivers* 1849

In 1859, an association of Concord's farmers hired Henry David Thoreau to measure the abutments of all the bridges that crossed the river upstream from Billerica. He was hired to survey the river by the farmers because they sought the removal of the downstream Billerica Dam (the farmers blamed the dam for causing the river to flood and ruining their hay).

ROBERT M. THORSON

# The Boatman

HENRY DAVID THOREAU'S  
RIVER YEARS



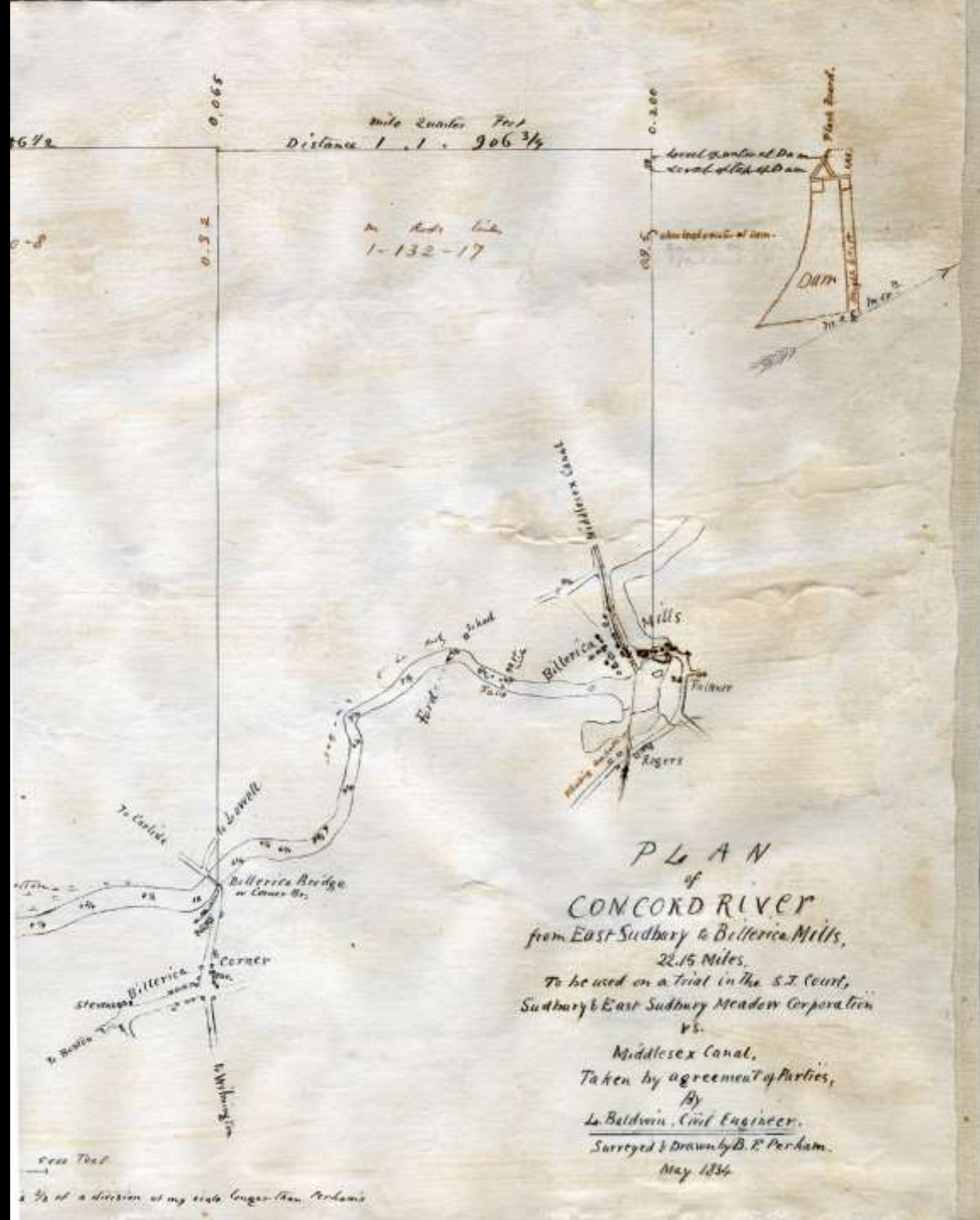
# Thoreau the River Man

One of the last projects that Thoreau ever worked on was an enormously detailed seven-and-a-half-foot map of the Concord River.

“[W]orking on his own, Thoreau inaugurated a truly scientific investigation of the largest, most powerful and wildest thing in his life, the Concord River.” Thorson

“This scroll-map, with its details of channel morphology, hundreds of soundings, seven distinct reaches, and 44 surveyed gradients, culminated Thoreau’s lifelong investigation into the ways and means of the Concord River”

Thorson, *The Boatman*



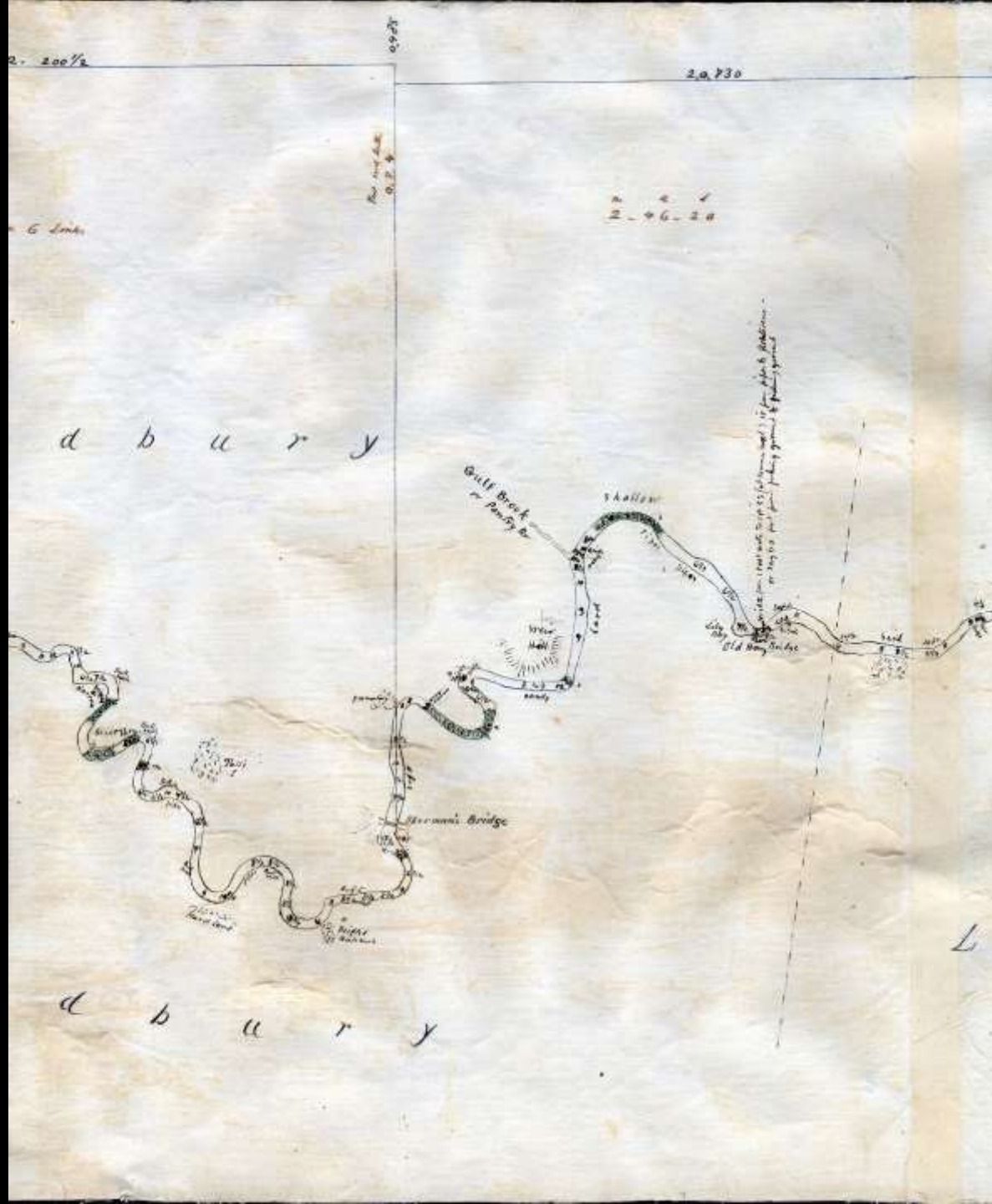
On a beautiful autumn day in 1851  
Thoreau exclaimed in his Journal,

“What meandering! The  
Serpentine, our river should be  
called? What makes the river love  
to delay here?”

Here come to study the law of  
meandering.”



Sinuosity is inversely proportional  
to slope



# The American Fall Line and River Transport

The Atlantic fall line was generally the head of navigation on Eastern rivers due to their rapids or waterfalls, and the necessary portage around them.

Numerous cities initially formed along the fall line because of the availability of water power to operate mills which concentrated mercantile traffic and labor.

In 1808, Treasury Secretary Albert Gallatin noted the significance of the fall line as an obstacle to improved national communication and commerce between the Atlantic seaboard and the western river systems

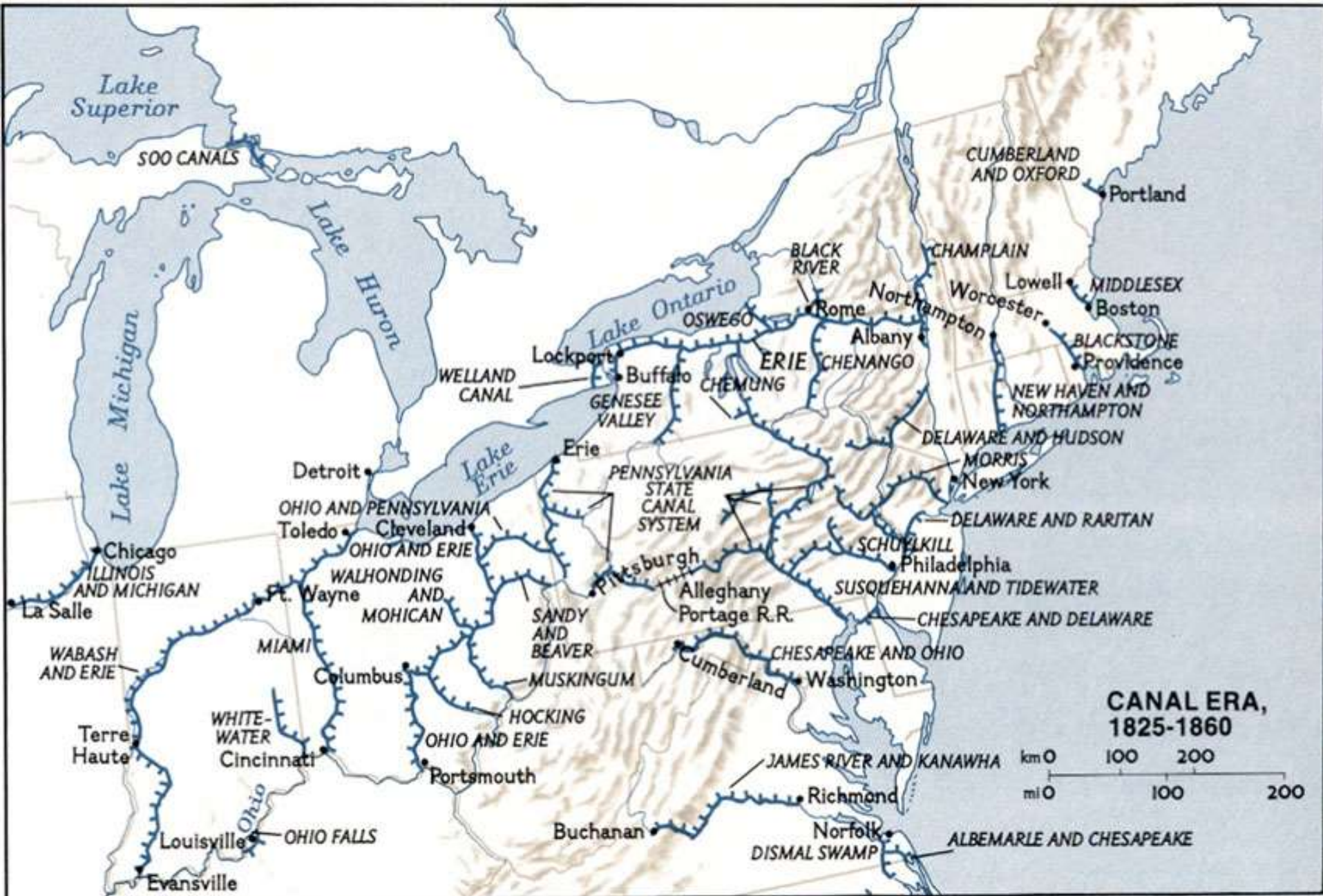
Great Falls Park, Potomac River, Virginia



Figure 1. Location of the Atlantic Coastal Plain Province.



# The American Fall Line and Canals 1825-1860





# Canals and the Hydraulic Empire

## The Erie Canal

First proposed in 1807, it was under construction from 1817 to 1825 when it officially opened on October 26, 1825.

The Erie Canal originally ran about 363 miles from Albany, New York, on the Hudson River to Buffalo, New York, at Lake Erie, at the time completing a navigable water route from New York City and the Atlantic Ocean to the Great Lakes.

The canal is widely regarded a chief cause that New York eclipsed Philadelphia as the largest city and port on the Eastern Seaboard of the United States.



# Ohio Canals

Construction of the canal began on July 4, 1825 with a ground breaking at Licking Summit near Newark, Ohio.

The Cleveland to Akron connection was completed by 1827 and the connection all the way to Portsmouth completed by 1832.

The entire canal system was 308 miles long with 146 lift locks and a rise of 1,206 feet.



# Canals and the American Hydraulic Empire



<http://www.americancanals.org>

# Principal Rivers, Roads, and Canals, 1840

## The Mississippi and American Hydraulic Empire





About 2,000 miles (3,219 km) across

0 200 400  
Miles

0 500 1,000  
Kilometers

Average Flow in cubic feet per second (cfs):

1,000 2,500 10,000 50,000 250,000 650,000



# The Hydraulic Empire Army Corps of Engineers



“Need for flood control and irrigation”  
“Central coordination and a specialized  
bureaucracy”

The Corps of Engineers, as it is known today, came into existence in 1802, when President Thomas Jefferson was authorized to "organize and establish a Corps of Engineers ... that the said corps ... shall be stationed at West Point in the State of New York and shall constitute a military academy."

During the first half of the 19th century, West Point was the major and, for a while, the only engineering school in the country.

Throughout the 19th century, the Corps built coastal fortifications, surveyed roads and canals, eliminated navigational hazards, explored and mapped the Western frontier, and constructed buildings and monuments in the Nation's capital.



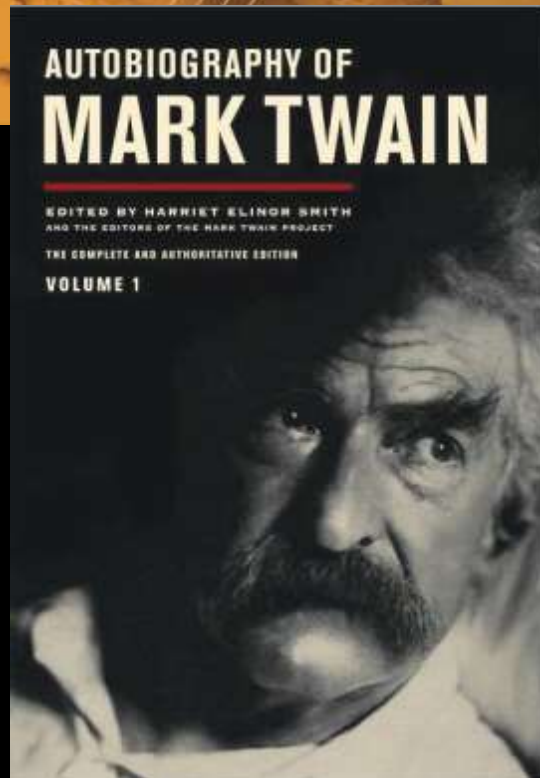
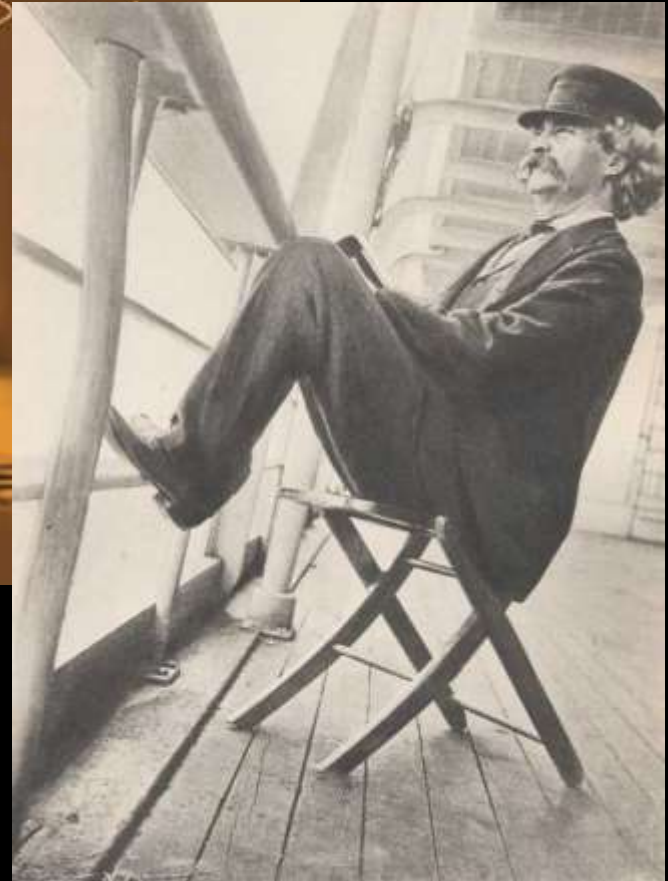
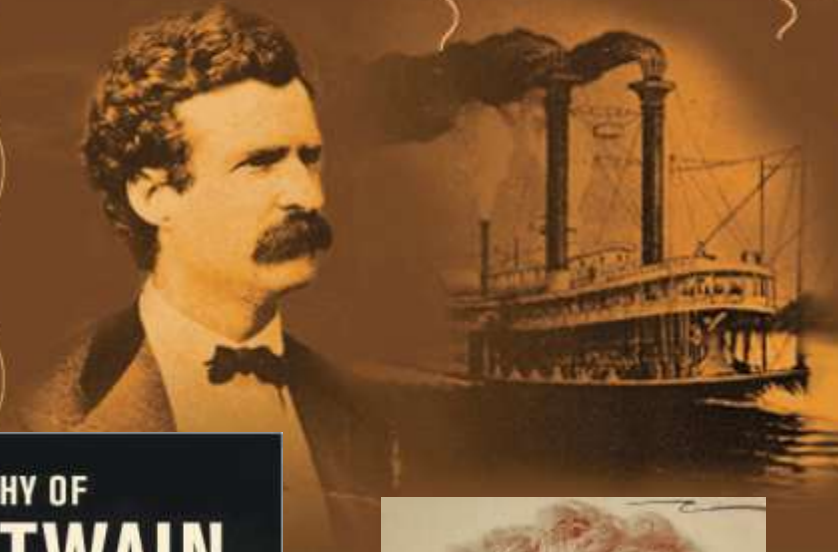
# Army Corps of Engineers and the Hydraulic Empire

In 1824, Congress passed an "Act to Improve the Navigation of the Ohio and Mississippi Rivers" and "to remove sand bars on the Ohio and planers, sawyers, and snags on the Mississippi" for which the corps was the responsible agency.





# Mark Twain's *Mississippi*

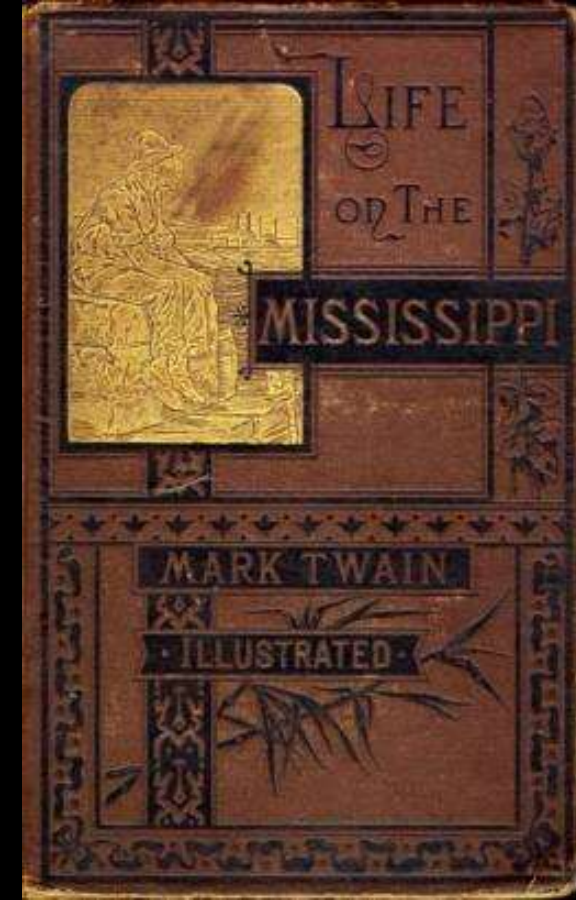


Imagination

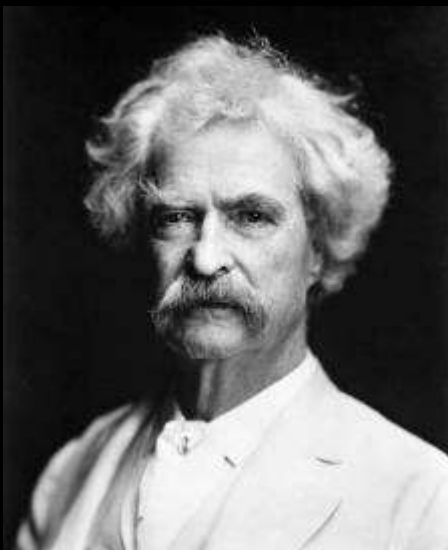
Mark Twain 1835-1910

## The Body of the Nation

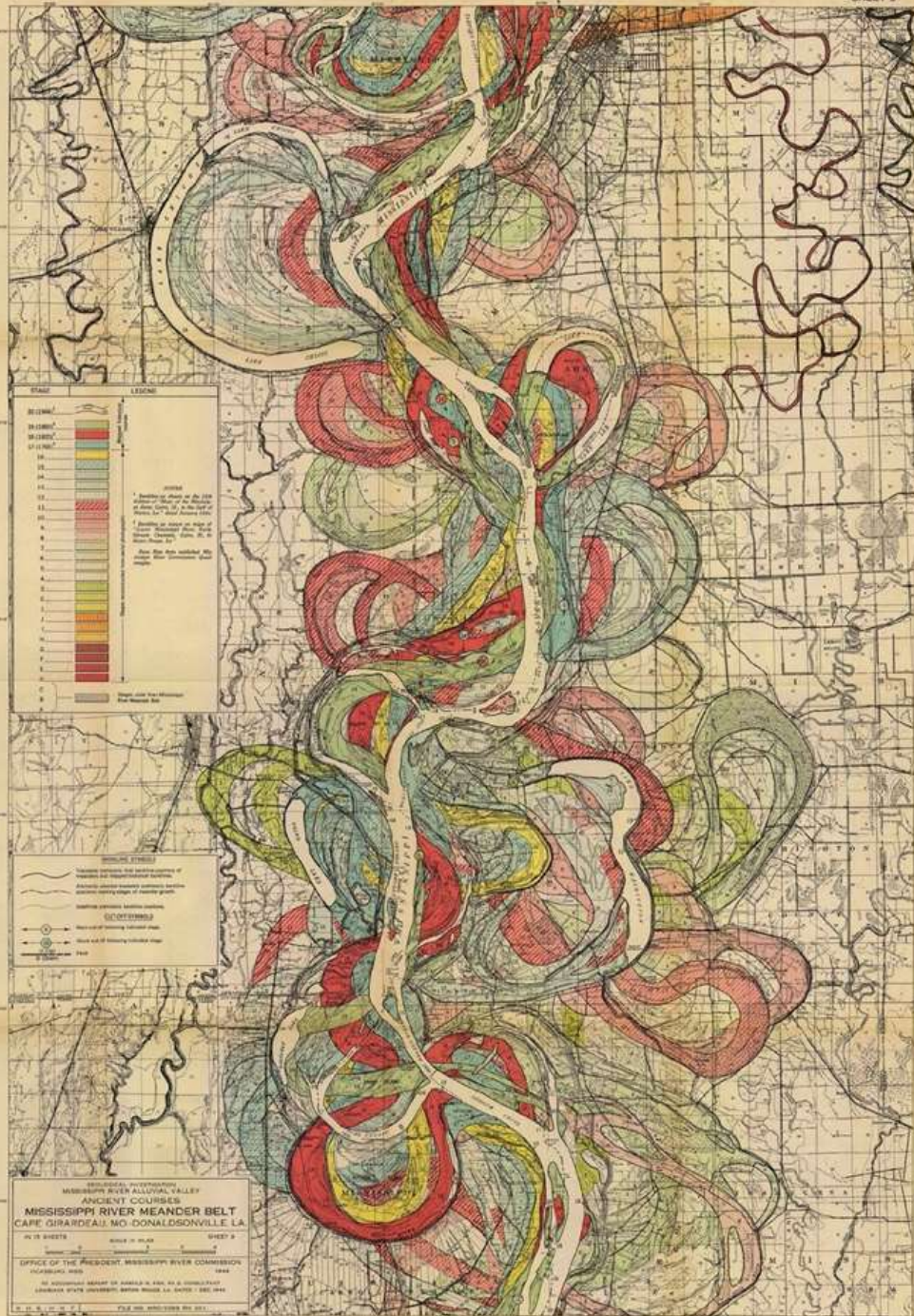
*Life on the Mississippi* is a memoir of his days as a steamboat pilot on the Mississippi River before the American Civil War, and also a travel book, recounting his trip along the Mississippi many years after the War. And, finally, a promotional book declaring the Mississippi River as America's most important river.



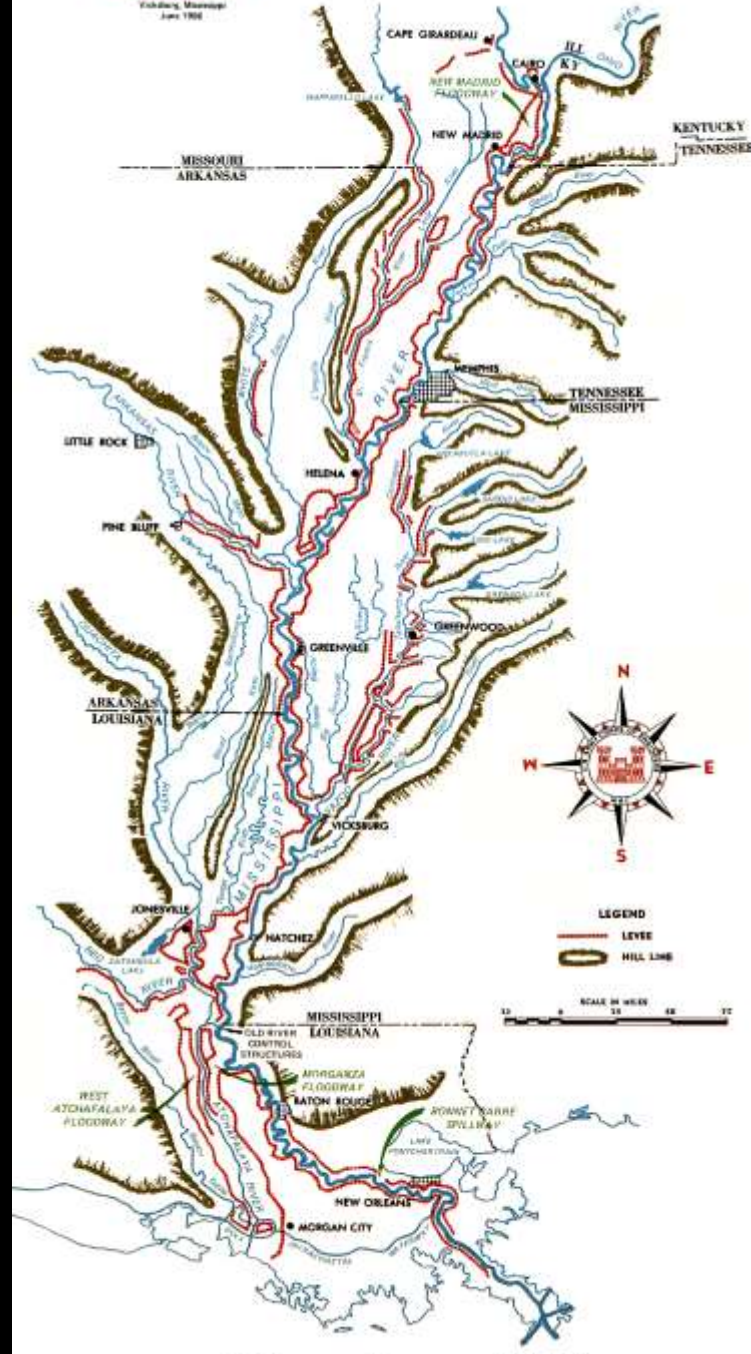
Published 1883



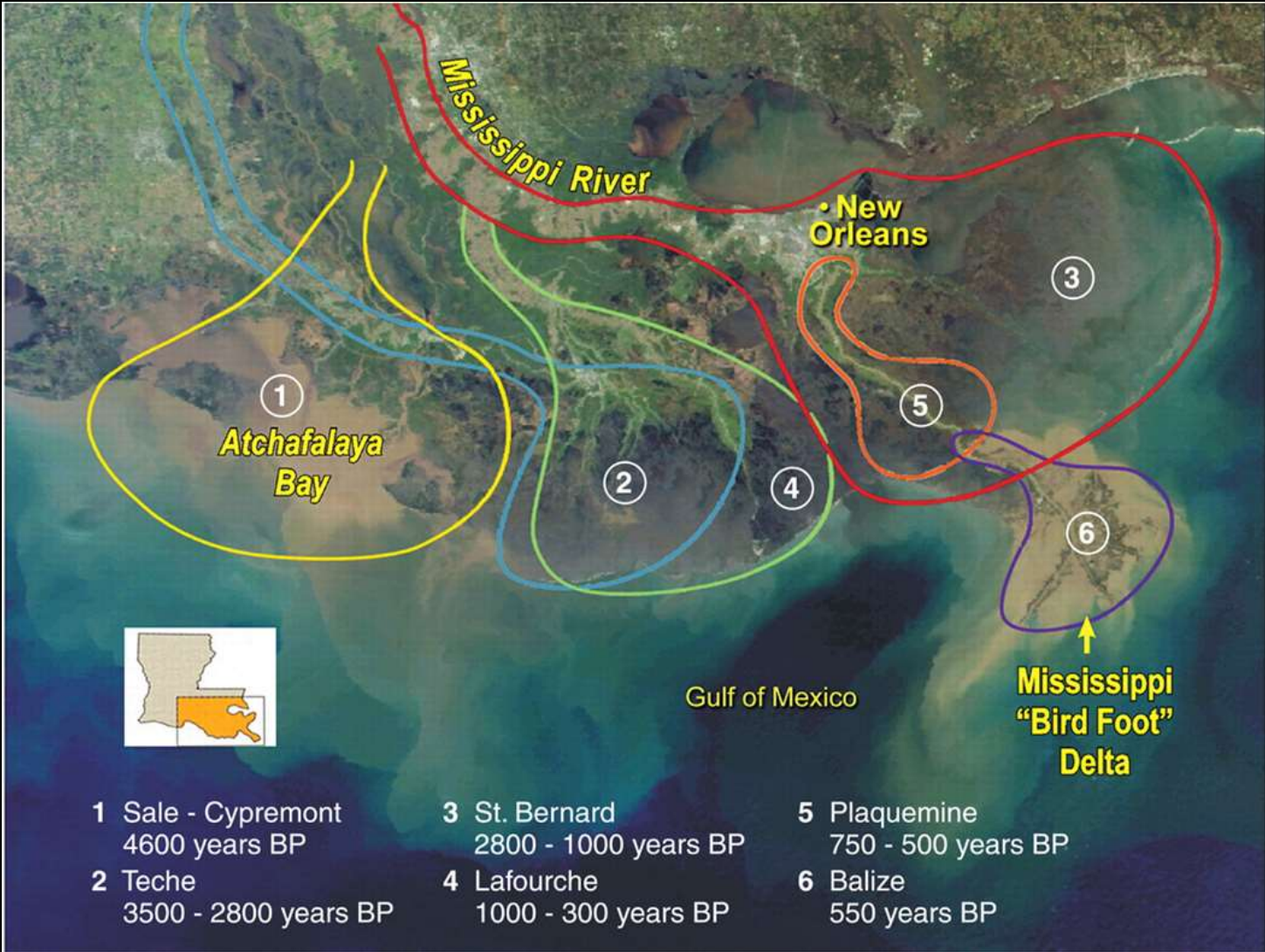
“BUT the basin of the Mississippi is the BODY OF THE NATION. All the other parts are but members, important in themselves, yet more important in their relations to this.”



Fishing, Missouri  
June 1966



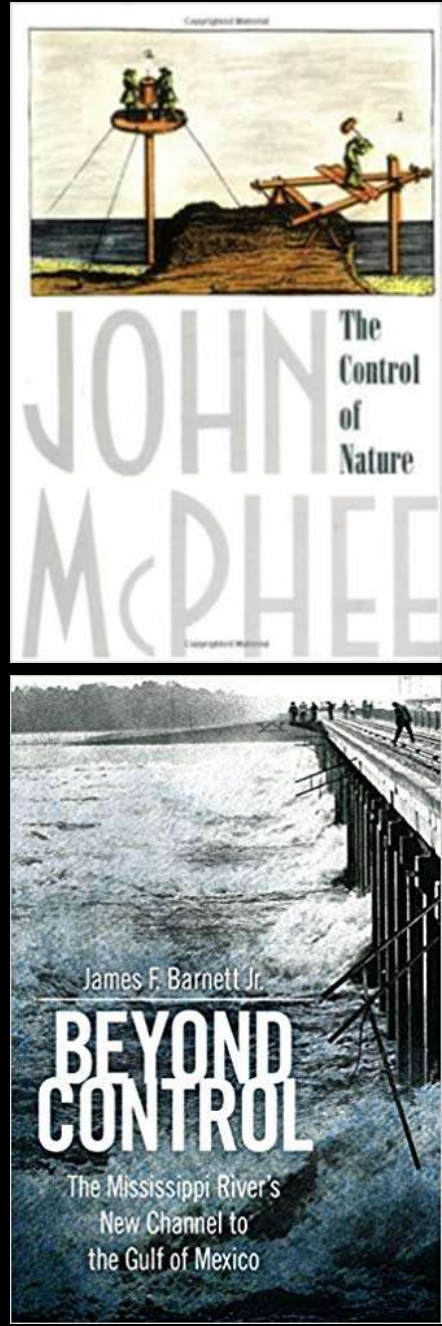
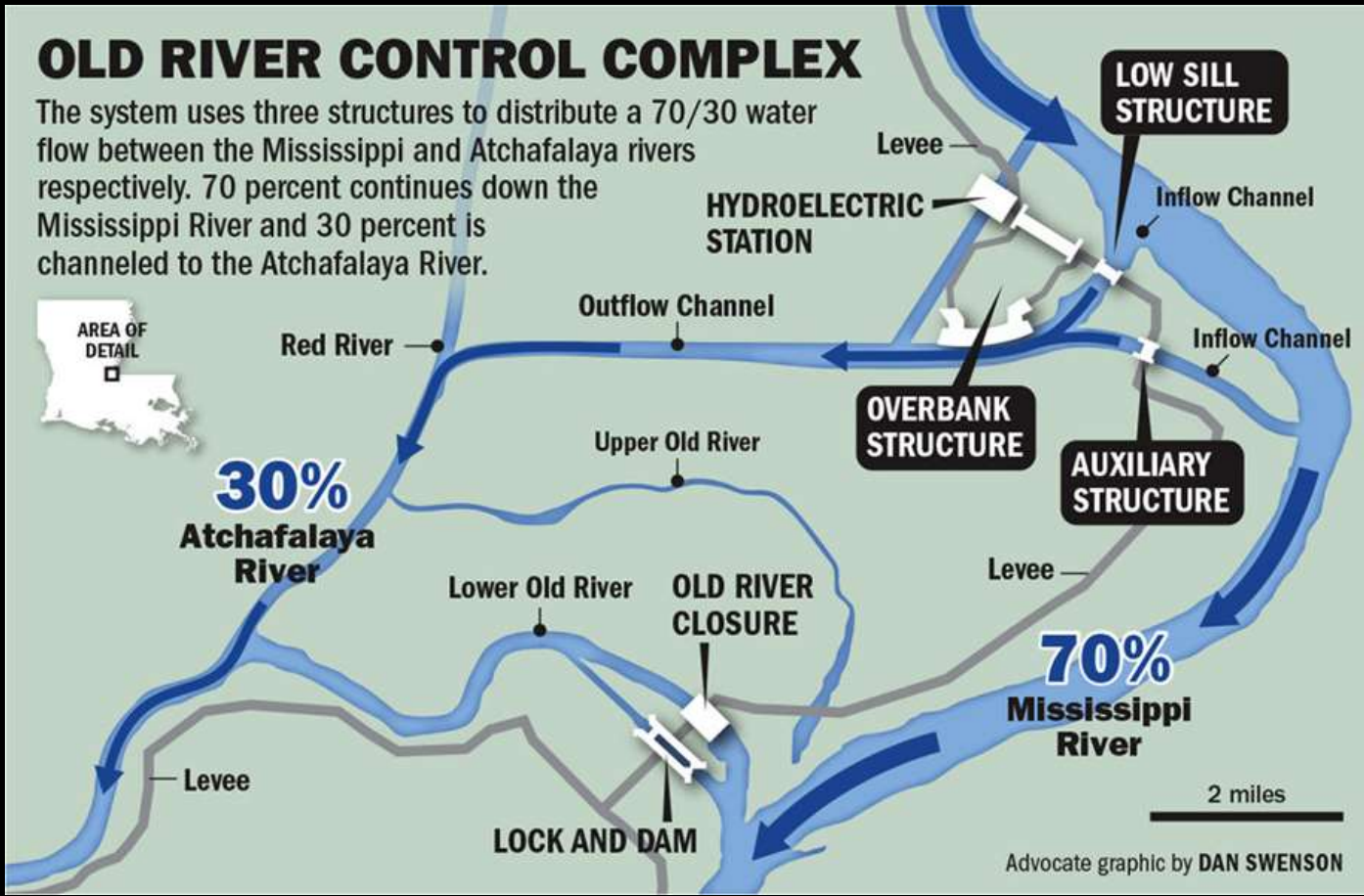
**Avulsion - the rapid abandonment of a river channel and the formation of a new river channel**



**Location of Mississippi River channels discharging water into the Gulf of Mexico over the past 5000 years. Notice the location changes from time to time, keeping all areas of the delta supplied with sediments that balance the natural sinking of the delta. Today, two-thirds of the flow are through the Bird Foot Delta (6) and one third through the Atchafalaya**

# America's Achilles' Heel

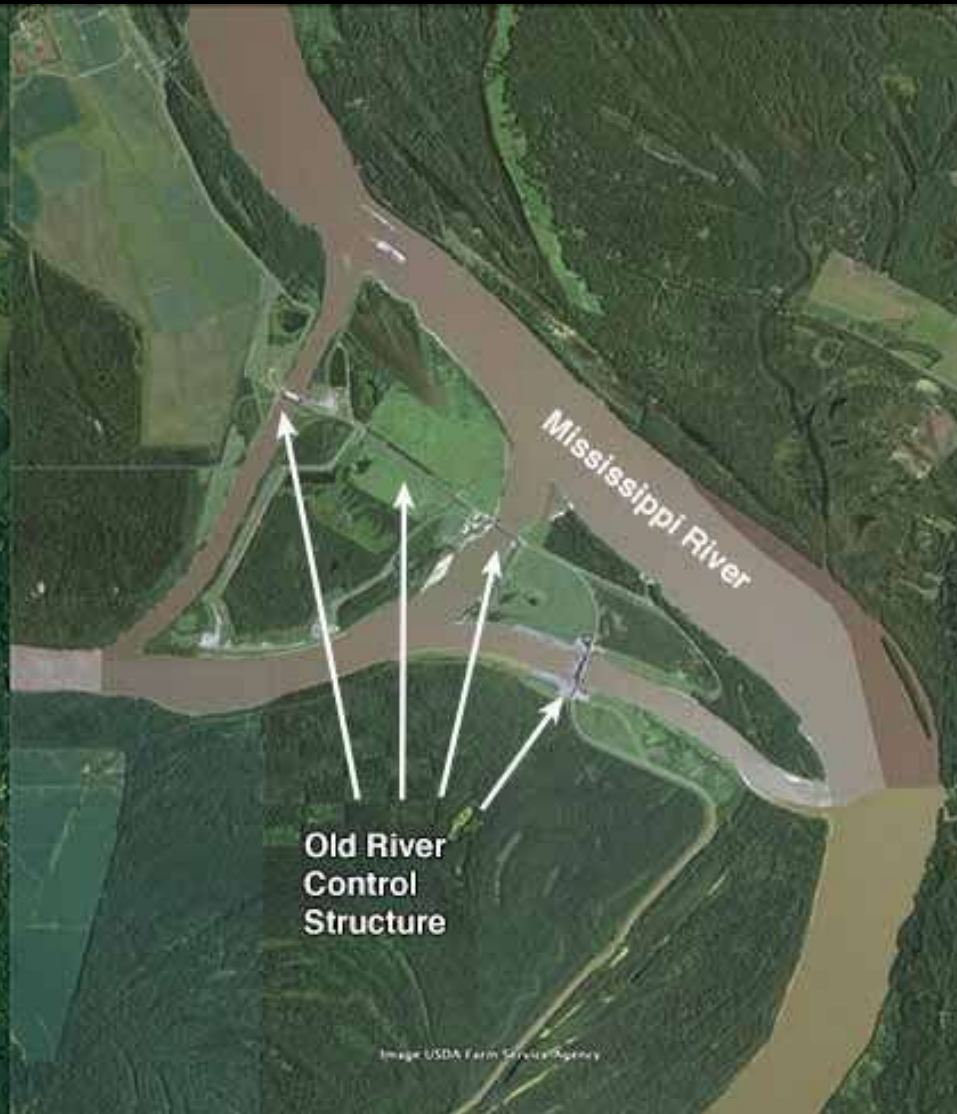
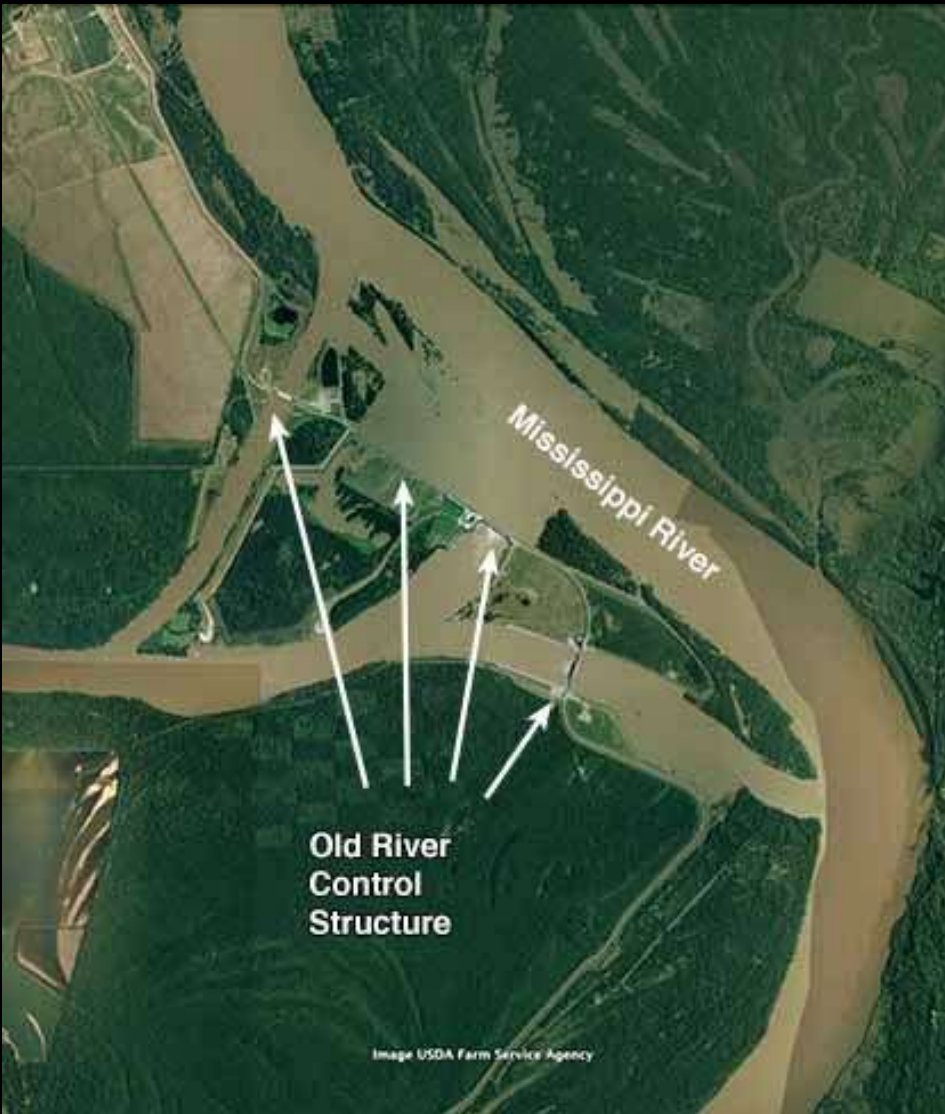
## Mississippi River's Old River Control Structure



# The Mississippi River's Old River Control Structure

2009 Flood

Normal flow



# MISSISSIPPI RIVER FLOOD CONTROL

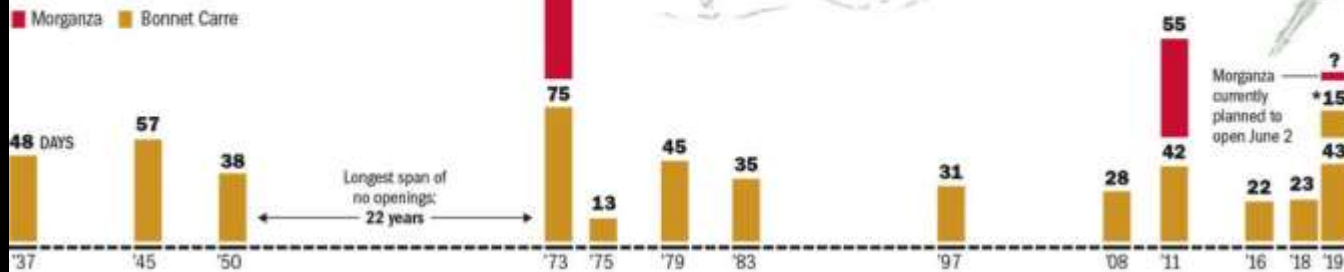
A look at the maximum designed flow rate (in cubic feet per second) of the Mississippi River flood control system, number of times the spillways have been opened and the potential flooding in the Atchafalaya Basin as a result of the high-water event



2019 Flood



## YEARS, NUMBER OF DAYS SPILLWAYS OPENED

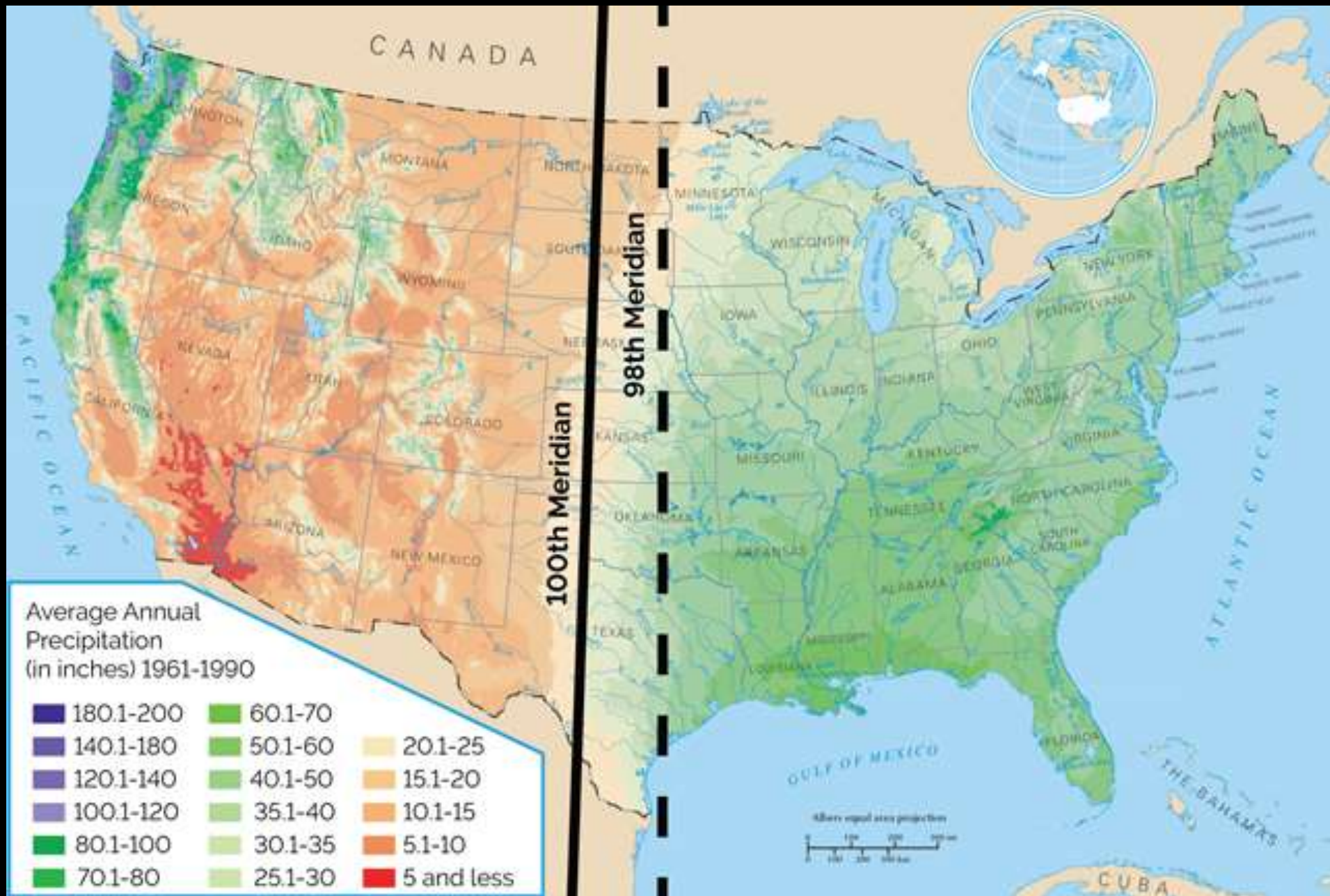


\*Second opening; currently remains open

Source: Army Corps of Engineers

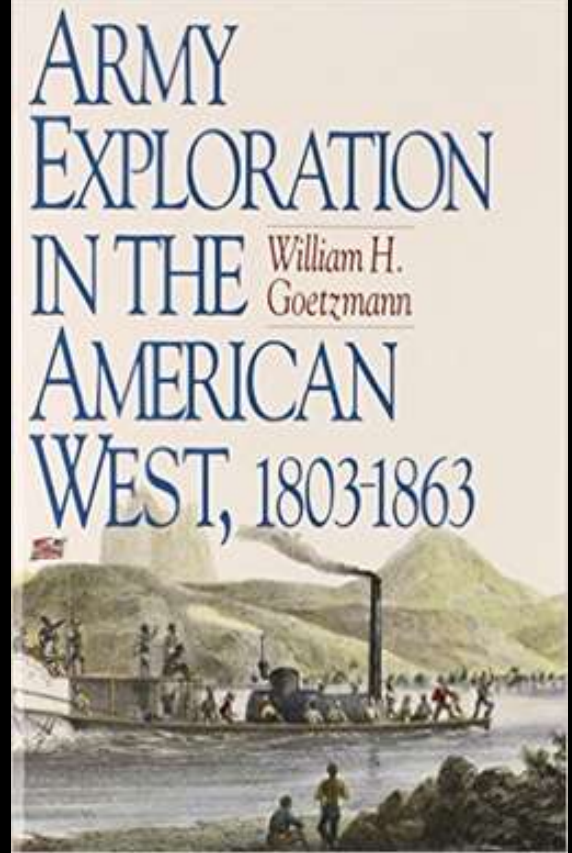
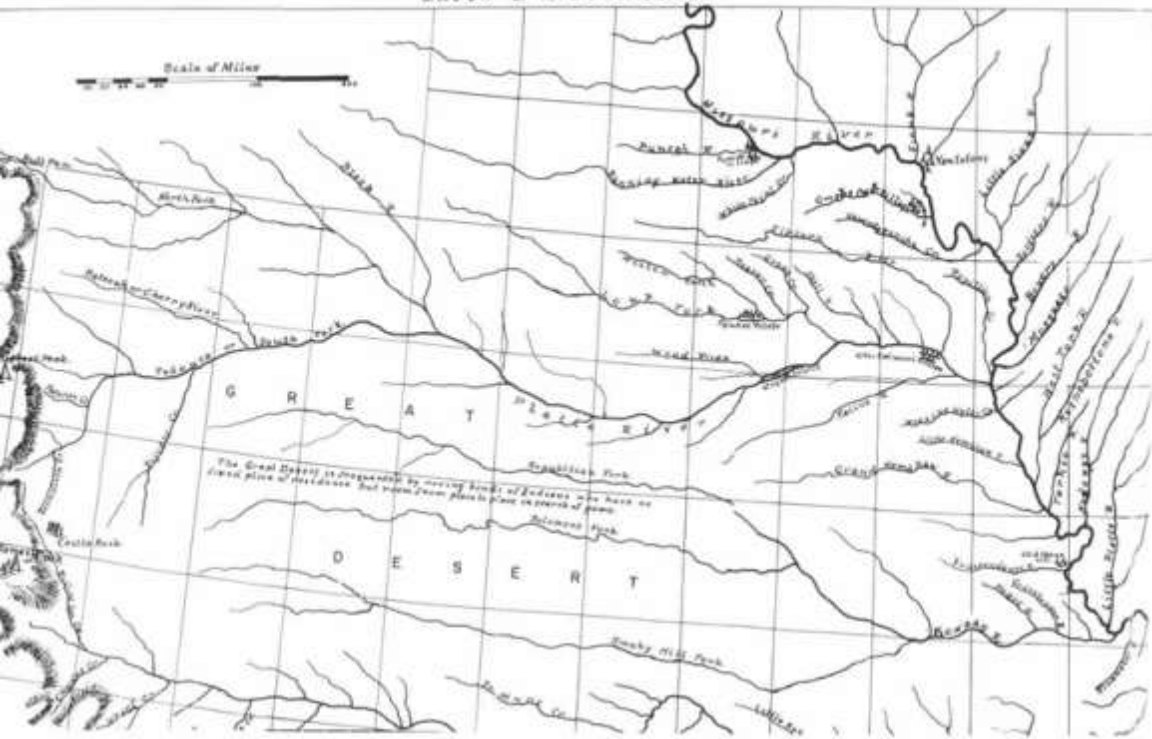
Advocate graphic by DAN SWENSON

# The West and Water – Exploration, Settlement, and Hydraulic Empire





THE GREAT AMERICAN DESIERT  
MAPPED AND NAMED BY  
MAJOR S. H. LONG 1819-1820.



## Exploration - The 1820 Long Survey and the Great American Desert

In his report of the 1820 expedition, Major Stephen Harriman Long wrote that the Plains from Nebraska to Oklahoma were "unfit for cultivation and of course uninhabitable by a people depending upon agriculture." On the map he made of his explorations, he called the area a "Great Desert."

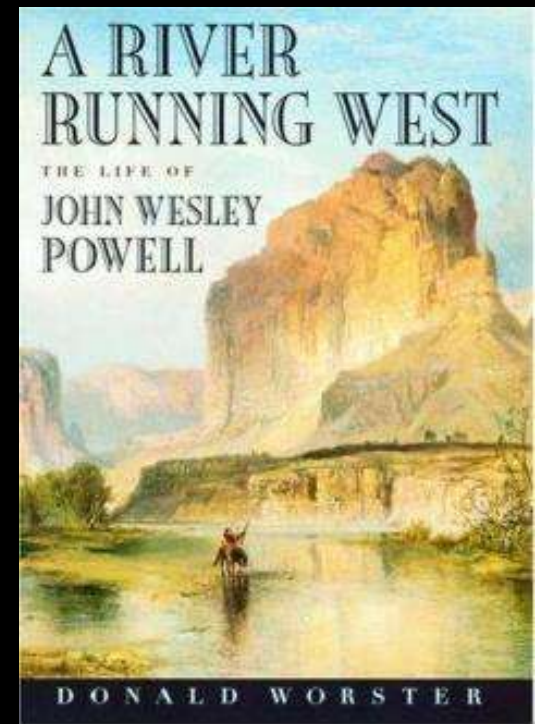
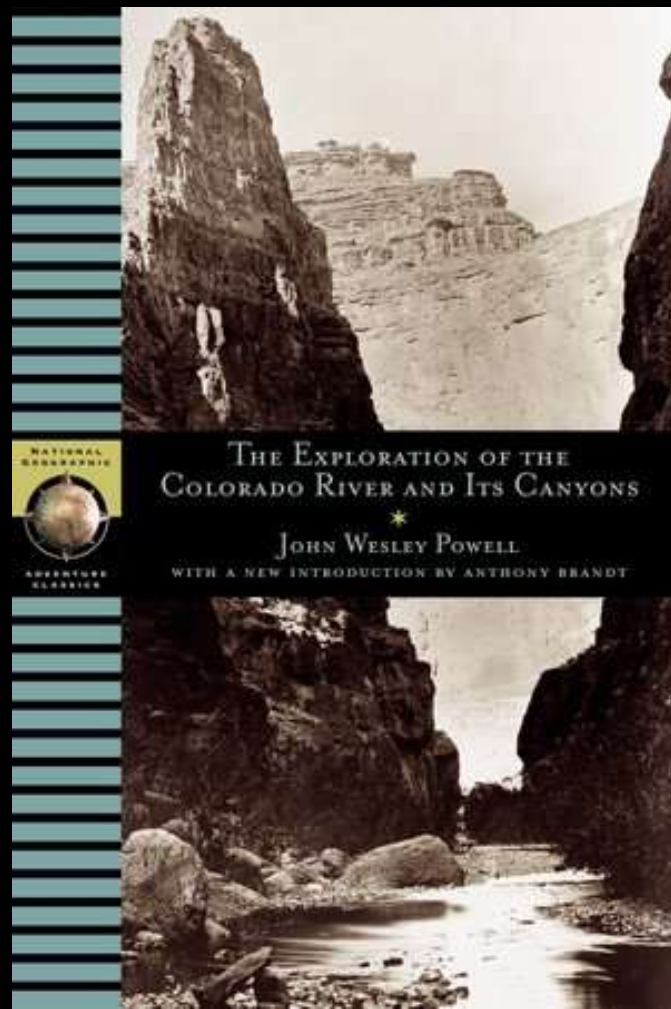
He argued that the eastern wooded portion of the country should be filled up before the republic attempted any further extension westward.



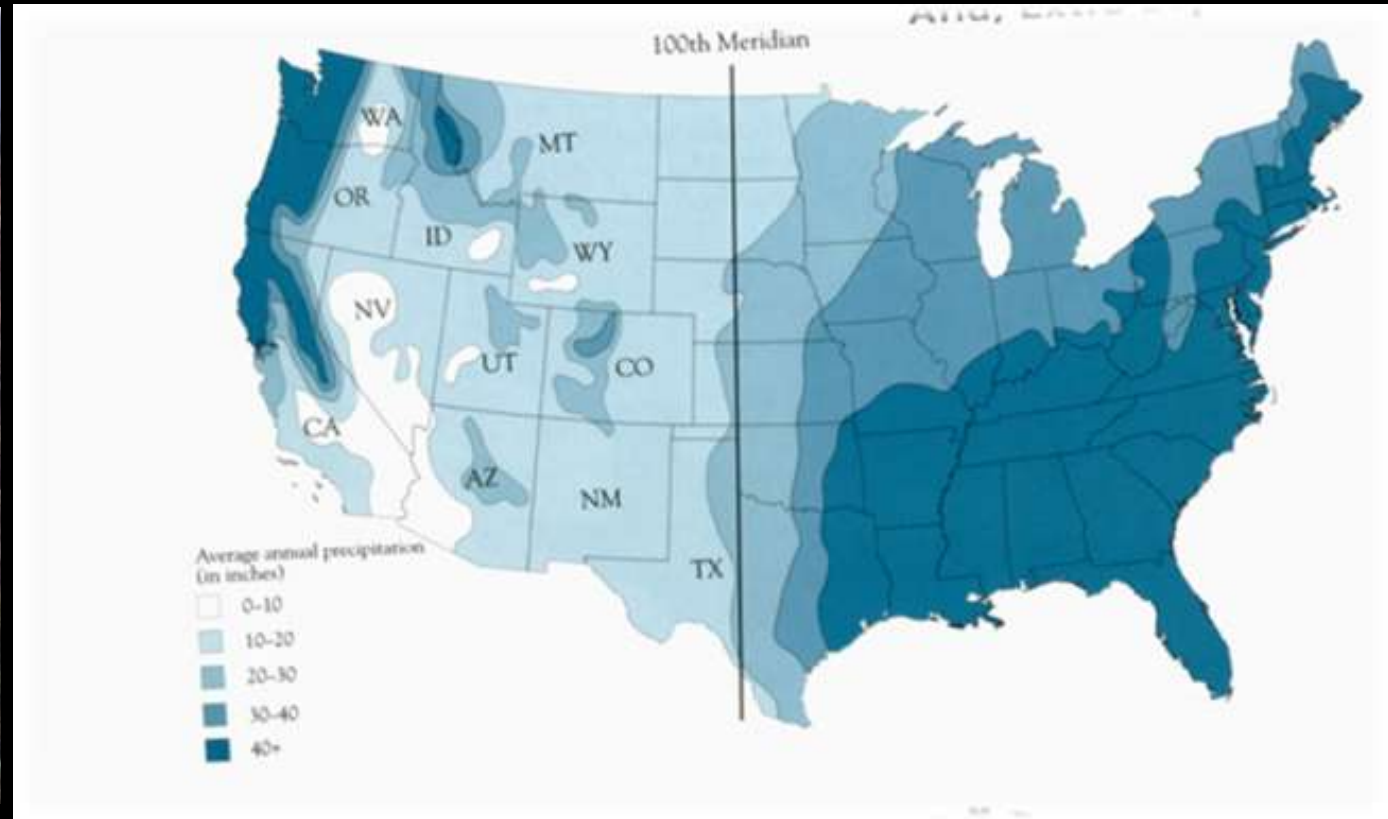
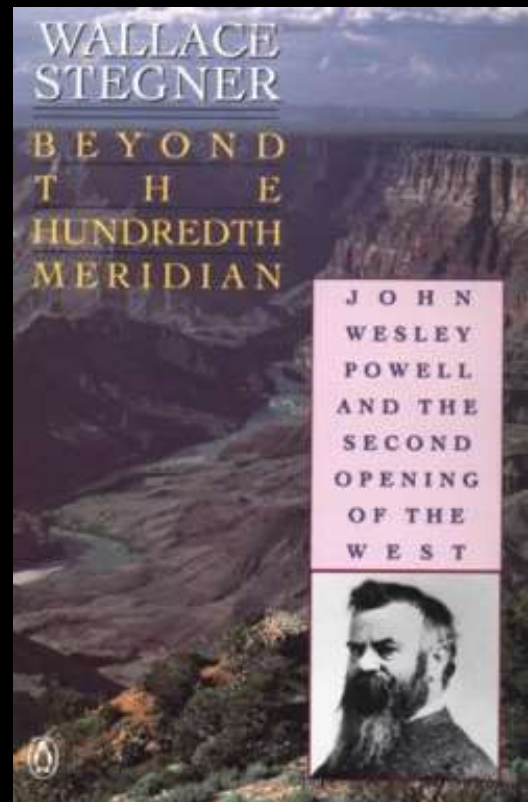
# Exploration - John Wesley Powell and the Colorado River

The Powell Geographic Expedition in 1869 was a groundbreaking exploratory expedition of the American West, led by John Wesley Powell.

It was the first-ever thorough investigation of the Green and Colorado rivers, including the first known passage through the Grand Canyon. Powell retraced the route in 1871–1872 with another expedition, resulting in photographs, an accurate map and various papers.



# Beyond the 100<sup>th</sup> Meridian and The Great American Desert



Powell's expeditions led to his belief that the arid West was not suitable for agricultural development, except for about 2% of the lands that were near water sources.

His *Report on the Lands of the Arid Regions of the United States 1878* proposed irrigation systems and state boundaries based on watershed areas (to avoid squabbles).

For the remaining lands, he proposed conservation and low-density, open grazing.



Walter Prescott Webb 1888-1963

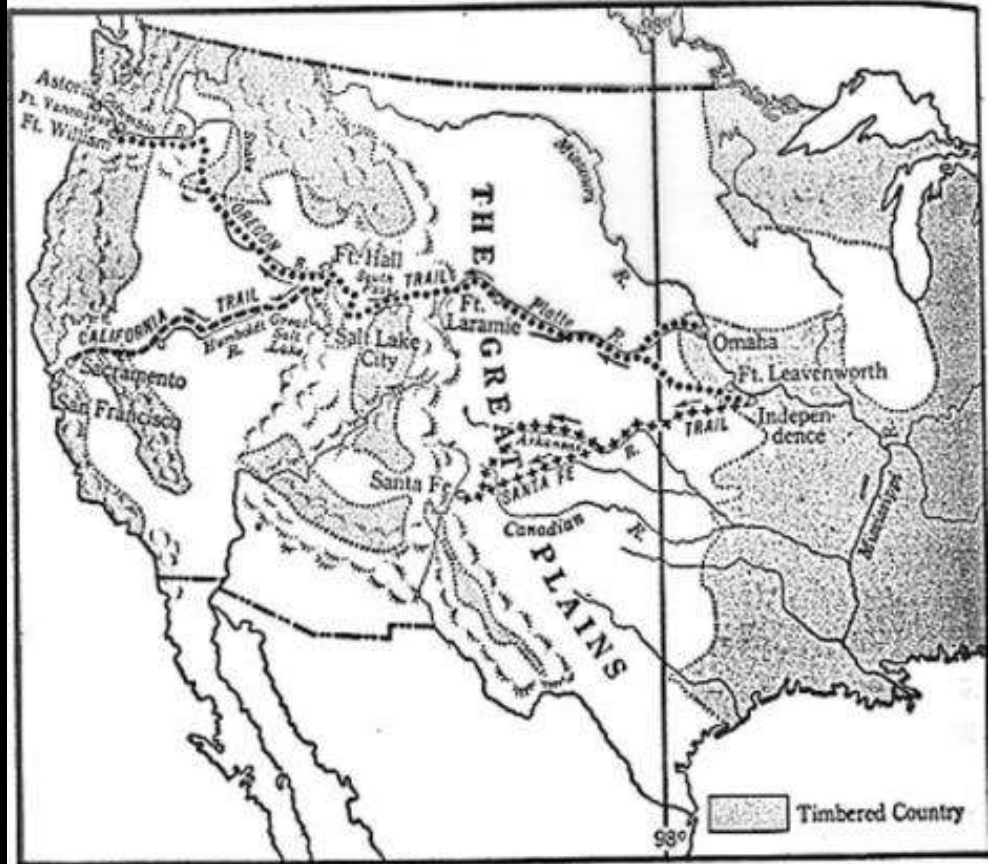
The Great Plains stand as a distinct environmental entity radically different from the wet timbered areas of the East.

Three characteristics differentiated the Plains from the East:

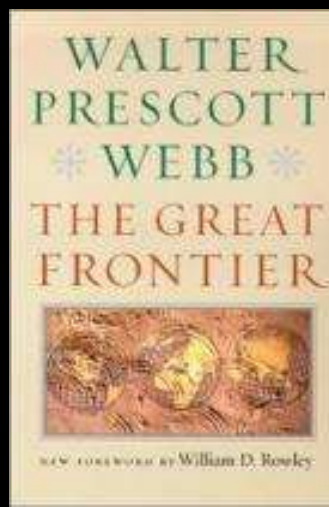
1. their flat geography,
2. the scarcity of timber,
3. their semi-arid climate.

Webb argued that between the 98th meridian and the western slope of the Rocky Mountain system from Canada to Mexico the two most important elements of life in the eastern United States - abundant rainfall or available water and large stands of timber - were missing.

This environment was absolutely foreign to the Eastern citizen of the United States, who found the Plains impossible to cope with for a long period of time.



The trans-Plains trails, usually called transcontinental



# Railroad Empire - "Rain follows the plow"

Railroad companies owned vast tracts of lands granted in return for building the lines, did not agree with Powell's opinion.

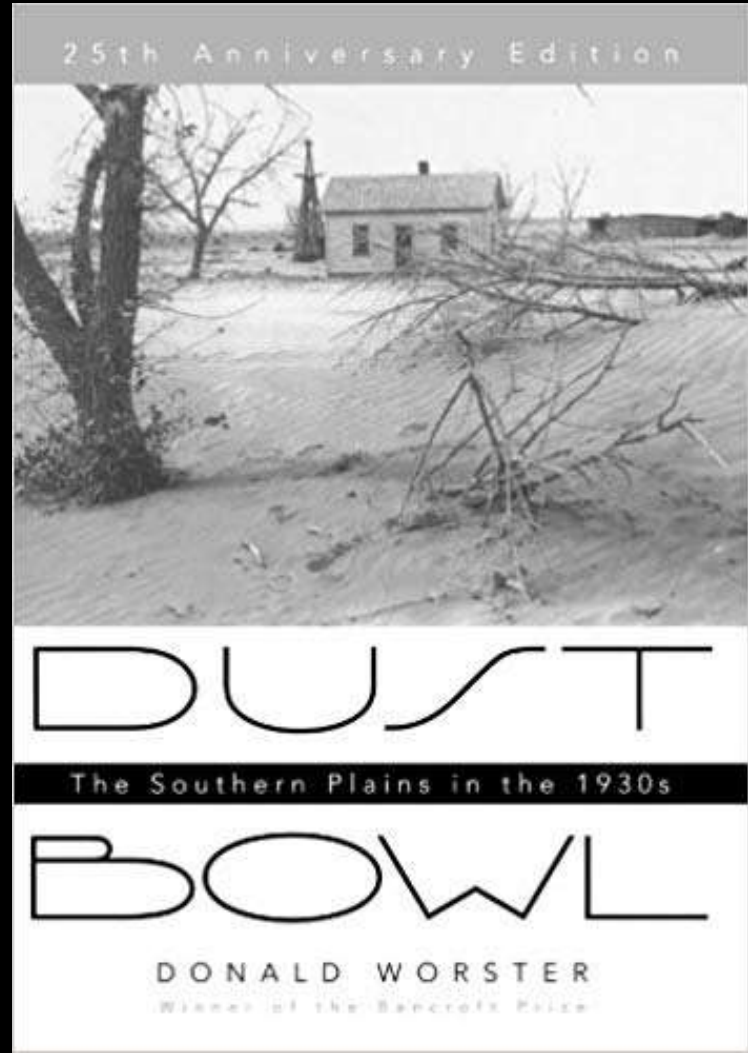
They aggressively lobbied Congress to reject Powell's policy proposals and to encourage farming instead, as they wanted to develop their lands. The politicians agreed and developed policies that encouraged pioneer settlement based on agriculture.

They based such policy on a theory developed by Professor Cyrus Thomas and promoted by Horace Greeley. They insisted that agricultural development of land causes arid lands to generate higher amounts of rain - "Rain follows the plow"





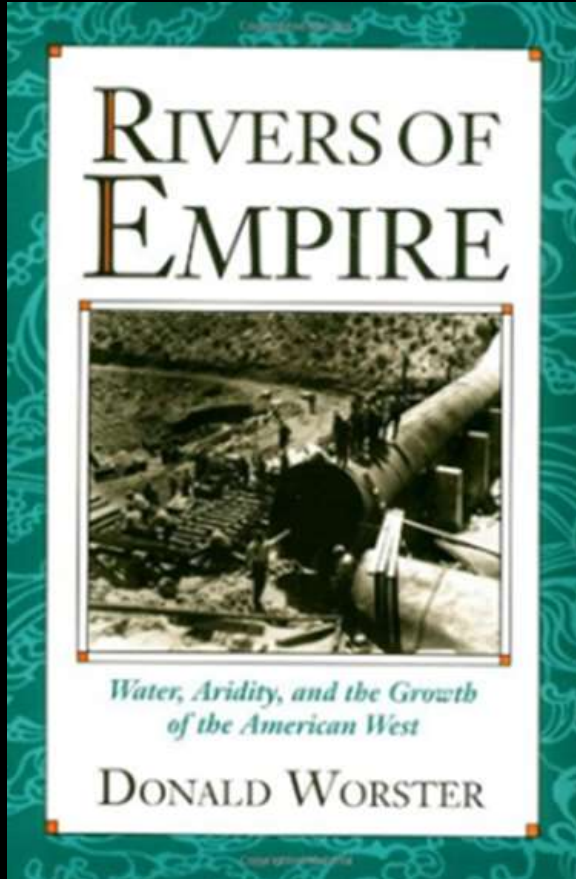
At an 1883 irrigation conference, Powell would remark: "Gentlemen, you are piling up a heritage of conflict and litigation over water rights, for there is not sufficient water to supply the land."



# Donald Worster – Rivers of Empire

Government-sponsored reclamation is a key factor in the growth and development of the West.

Worster argues that rivers were manipulated to create an American hydraulic empire, but along with the creation came a host of social, economic, and political problems.



**"The Bureau that Changed the West"**



# Irrigation Empire – The Bureau of Reclamation

“Central coordination and a specialized bureaucracy”

Established in 1902, the United States Bureau of Reclamation is a federal agency under the U.S. Department of the Interior, which oversees water resource management, specifically as it applies to the oversight and operation of the diversion, delivery, and storage projects that it has built throughout the western United States for irrigation, water supply, and hydroelectric power generation.

Currently USBR is the largest wholesaler of water in the country, bringing water to more than 31 million people, and providing one in five Western farmers with irrigation water for 10 million acres of farmland.

USBR is also the second largest producer of hydroelectric power in the western United States and operates about 180 projects in the 17 western states

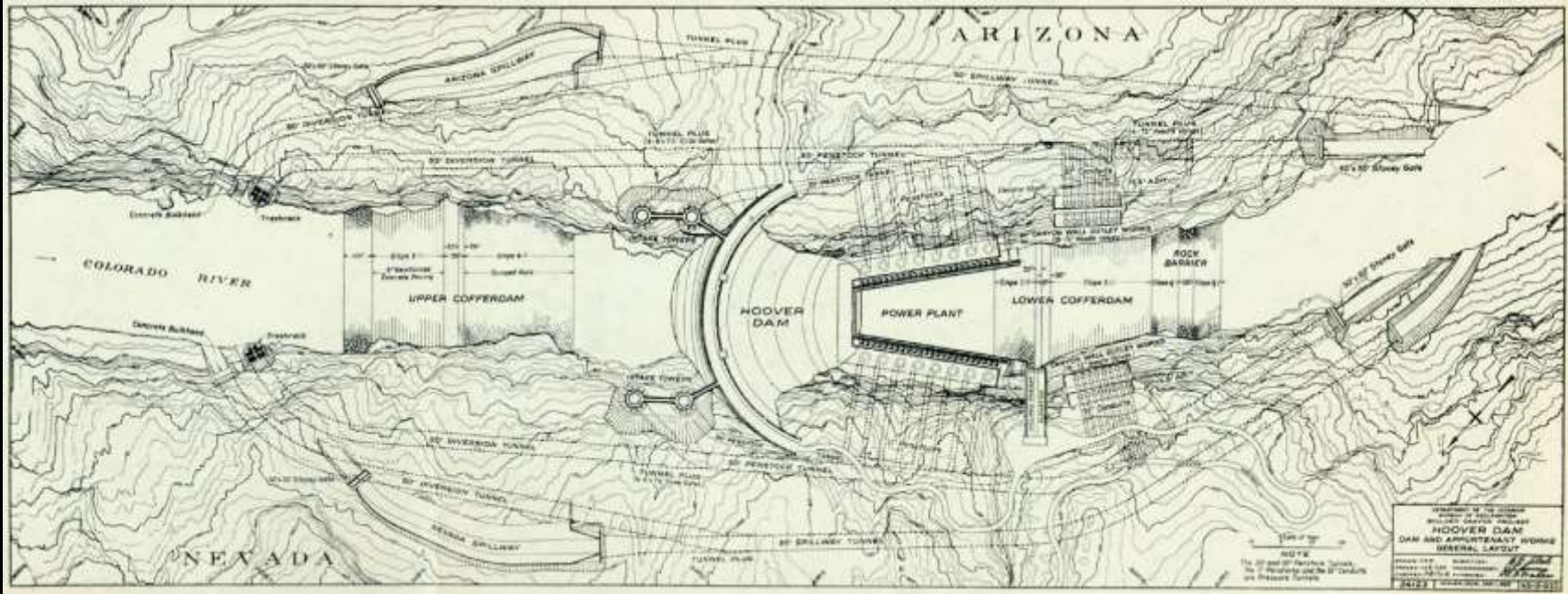
**RECLAMATION**  
*Managing Water in the West*





# The Colorado River and Hoover Dam

In the 1930s, the need for power in the Southwest led to the building of the largest concrete construction in the world at that time, the Hoover Dam. Constructed between 1931 and 1936



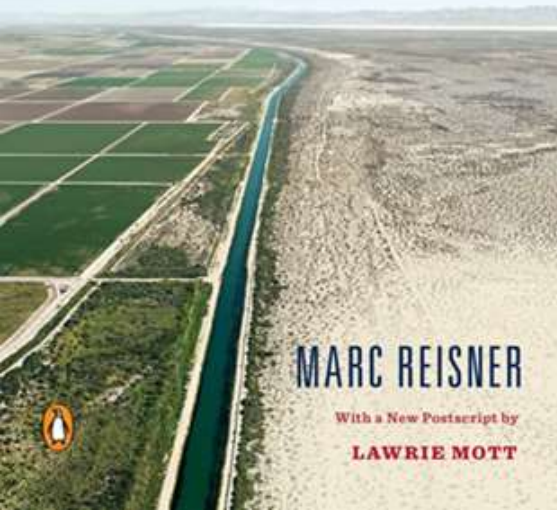
"The definitive work on the West's water crisis." —Newsweek

# CADILLAC DESERT

THE AMERICAN WEST and its  
DISAPPEARING WATER

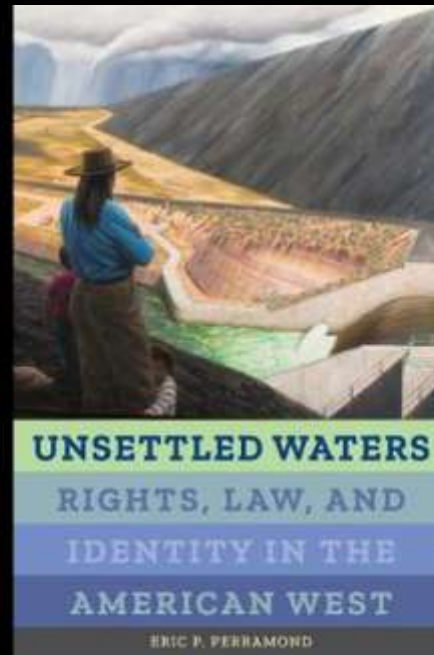
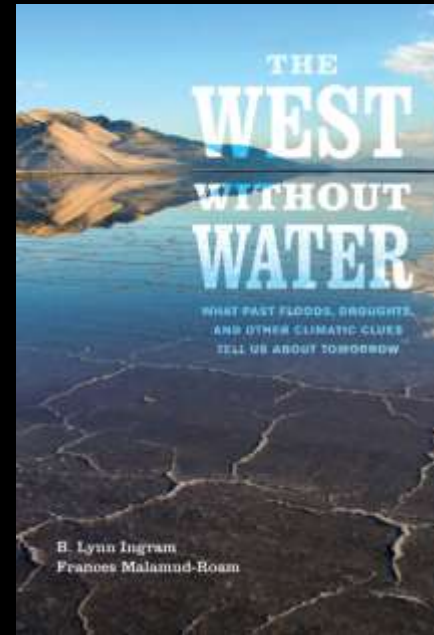
MARC REISNER

With a New Postscript by  
LAWRIE MOTT

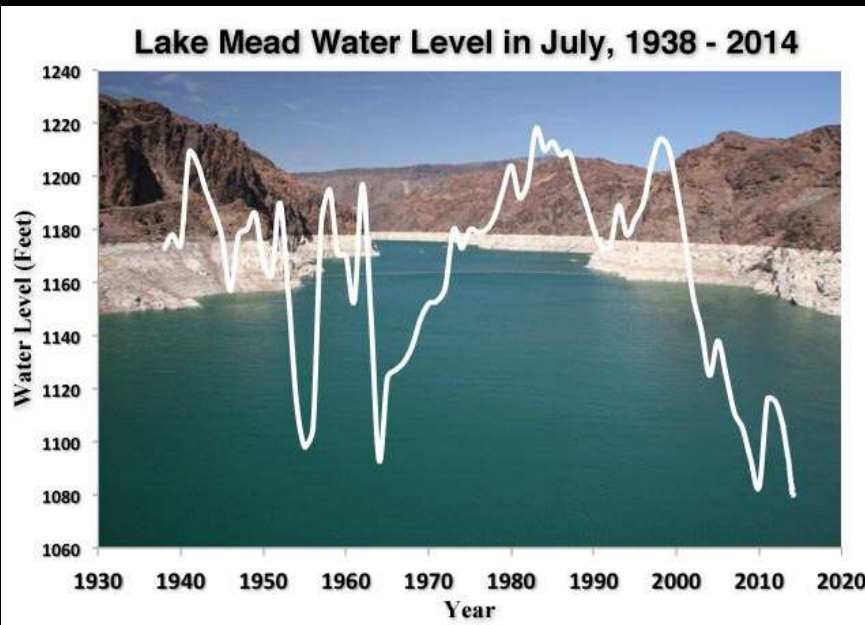


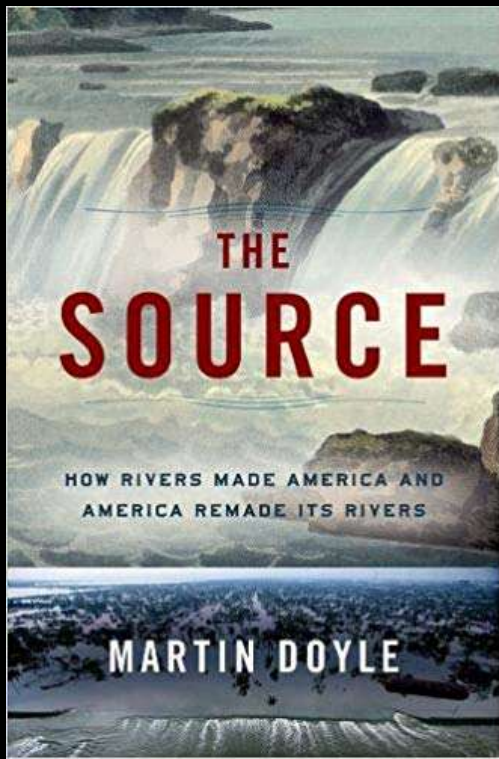
# Limits of Empire – Droughts, Urbanization, Agricultural Use of Water

## Hoover Dam - Lake Mead 2011



Despite the above average 2019 snowpack, the Colorado River Basin continues to experience its worst 20-year drought on record, dating back to 2000. This 20-year period is also one of the driest in the 1,200-year paleo record.





# Rivers of Empire

"American Rivers" 2009

Tom Russell

We named 'em for Indians, our guilt to forsake  
The Delaware, the Blackfoot, the Flathead and Snake  
Now they flow past casinos and old hamburger stands

They are waving farewell to the kid on the land  
With their jig-sawed old arteries so clogged and defiled  
No open-heart miracle is gonna turn 'em back wild

Past towns gone to bankers past fields gone to seed  
All cut up and carved out so divided by greed  
And old grandfather catfish with his whiskers so long  
And his life in a struggle cuz the oxygen's gone

And it's mama I miss you, I woke up and screamed  
American rivers roll deep through my dreams  
Colorado, Allegheny, Shenandoah, Sus-qua-hay-nee  
And the Wabash and the Hudson and the brave Rio Grande  
I was a kid there, asleep in sand, near your waters...

