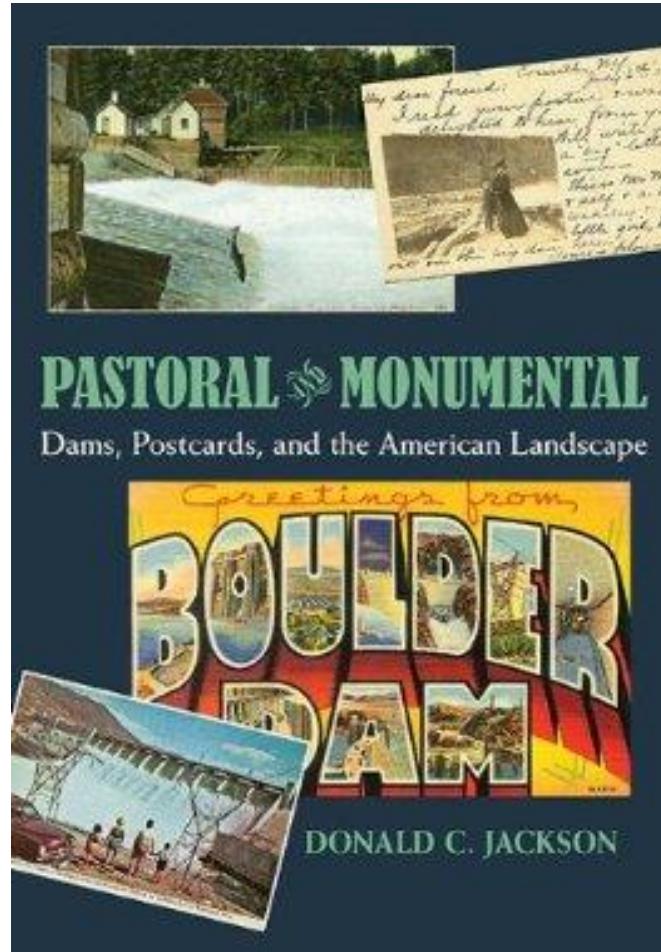


Dams Water Energy & Sustainability: A Historical Context

DC Jackson – Lafayette College
National Academy of Sciences
Water/Energy Roundtable
May 20, 2014

Dams Water Energy...

Dams and the (Cultural) Landscape...



Dams Water Energy...

Water & Power - An American Tradition



Waldoboro, Me., Old Mill and Dam.

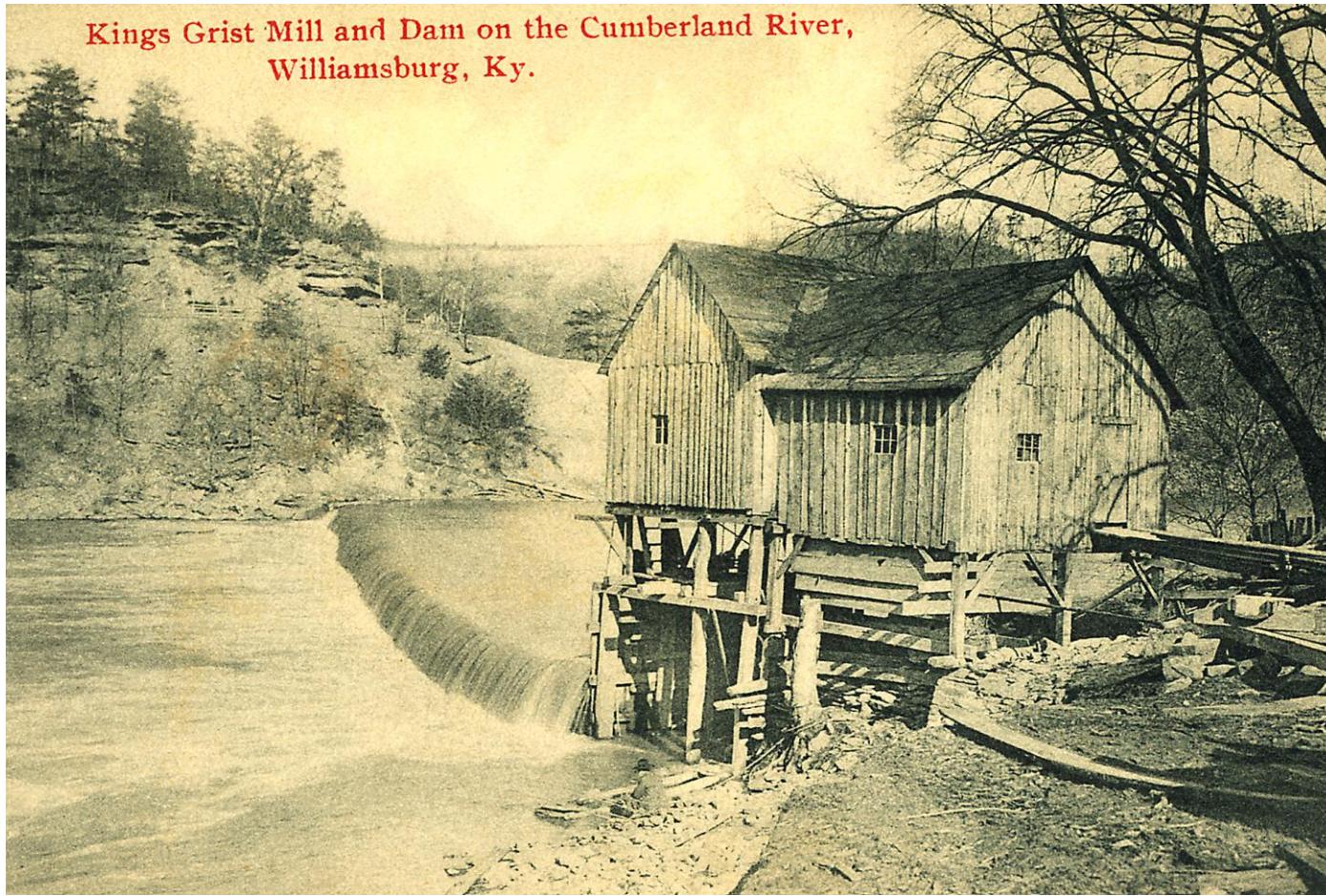
Dams Water Energy...

Rural Grist Mill – Hudson River Valley



Dams Water Energy...

Rural Grist Mill - Kentucky



Dams Water Energy...

Rural Grist Mill - Georgia



Dams Water Energy...

Slater Mill: 1793 Textile Mill Dam



Dams Water Energy...

Waltham Mill – Charles River 1814



Copyright 1905 by the Rotograph Co.

A 6938 Boston Mfg. Co., Cotton Mill, Waltham, Mass

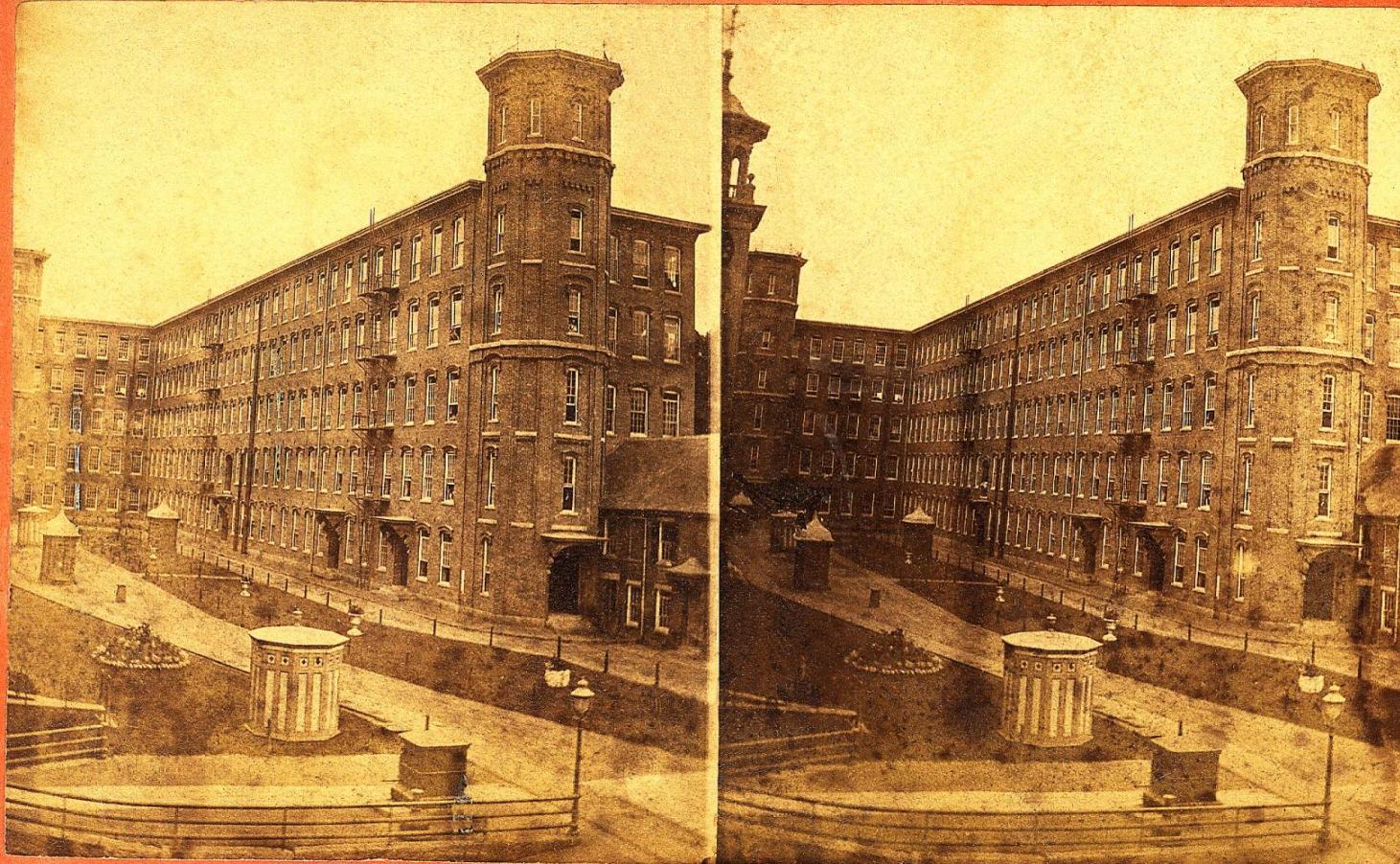
Dams Water Energy...

Lowell: Merrimack River 1820s



Dams Water Energy...

Boott Mill – Lowell 1820s

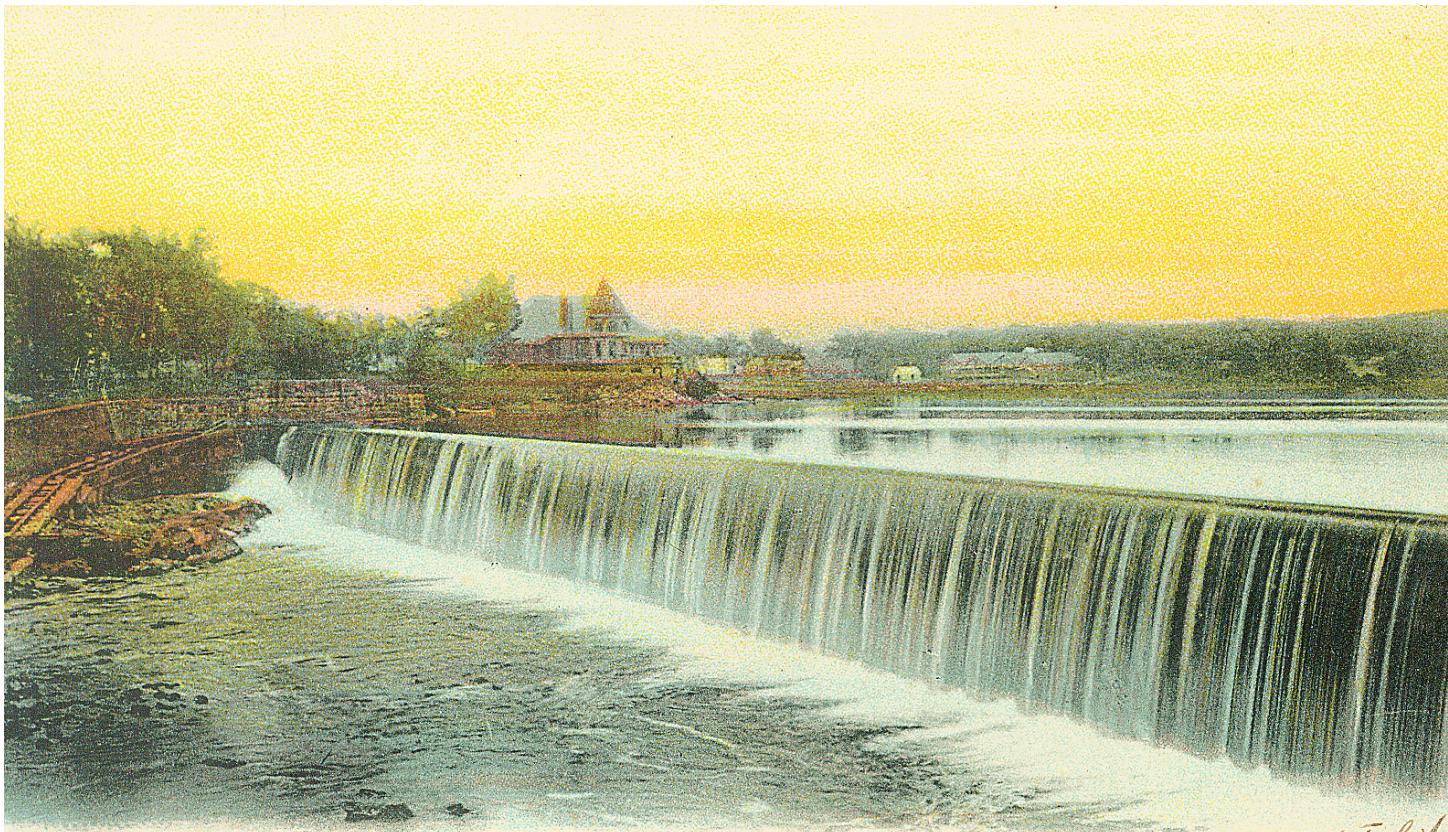


NEW SERIES, LOWELL, MASS.

MARSTON & PRINGLE, 90 MERRIMACK ST.

Dams Water Energy...

Lawrence MA: Great Stone Dam 1848

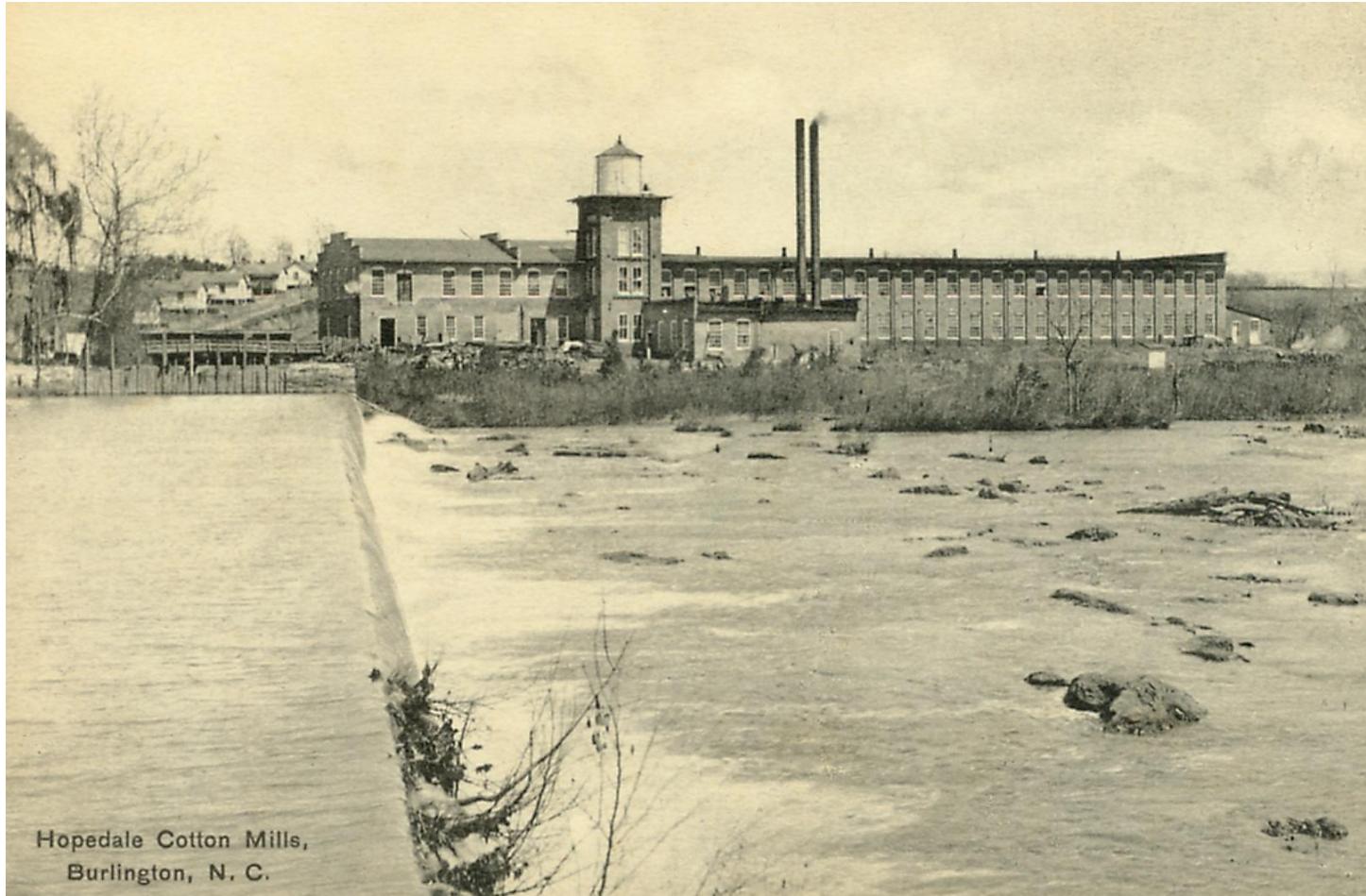


G 21510 The Great Dam, Merrimack River, Lawrence, Mass.

G 21510 The Great Dam, Merrimack River, Lawrence, Mass
Dear Berrie: - As I have not time to write will send you this card to let
you know I am still alive with love from May France 125 Glenscott Avenue
* 914th Park Mass

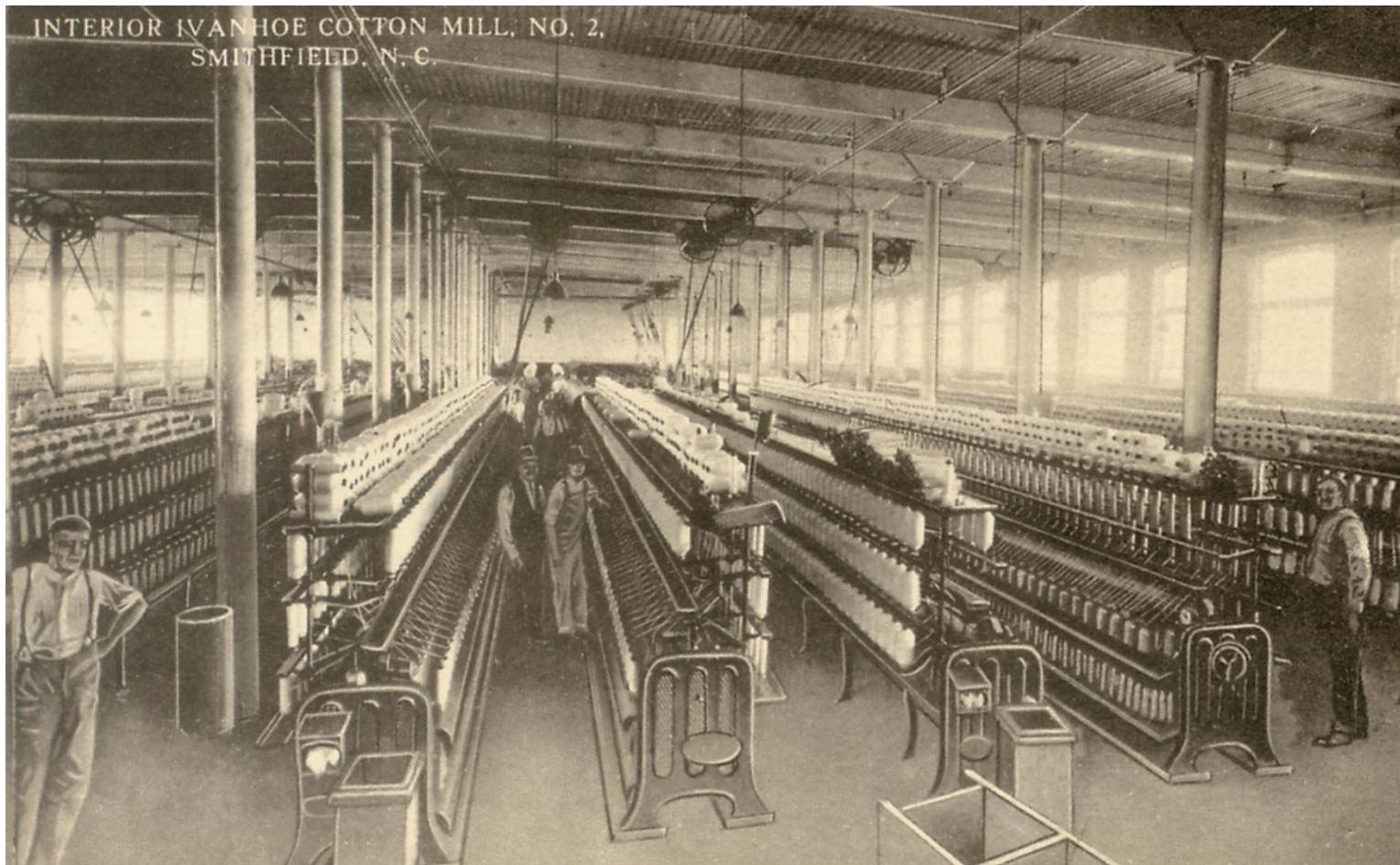
Dams Water Energy...

Textile Mills Move South – 1890s



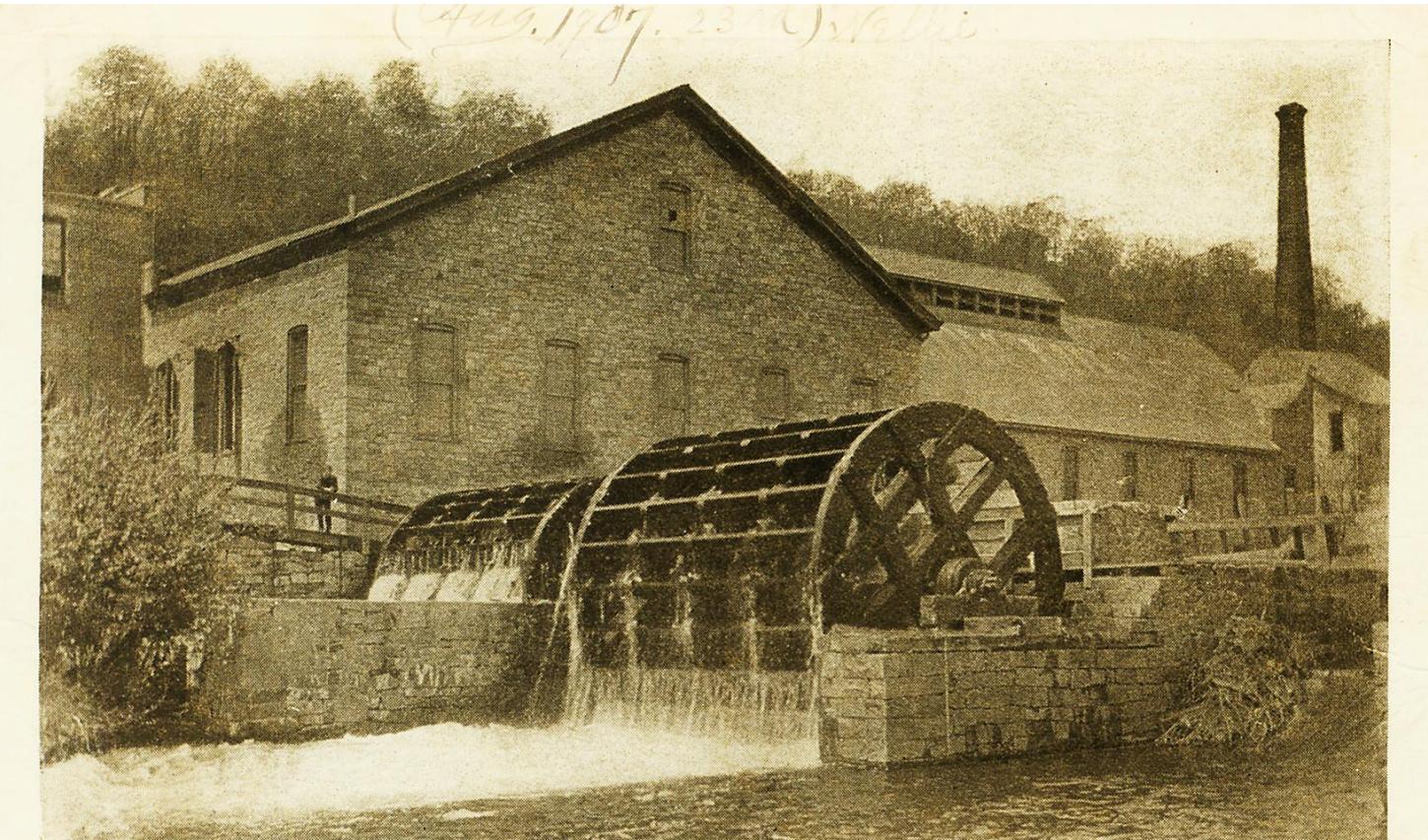
Dams Water Energy...

19th Cent. Mechanical Power Transmission



Dams Water Energy...

Breast Wheel Technology



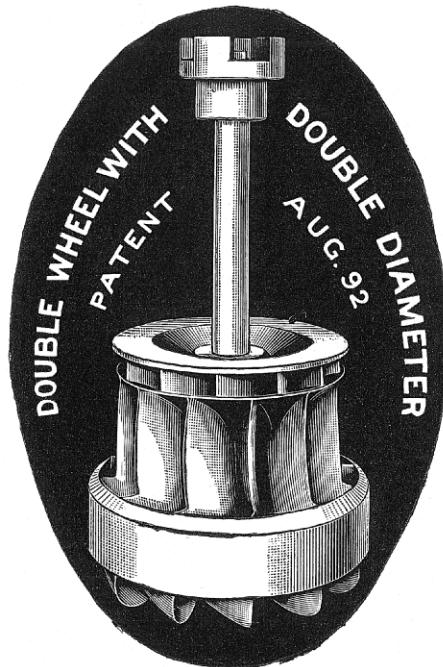
75. BUCKS COUNTY (PA.) VIEWS
Arnold Bros., Printers, Rushland, Pa.

WATER WHEEL AT UNION PAPER MILLS, NEW HOPE, for raising water from the river into the canal. It has been in operation many years.

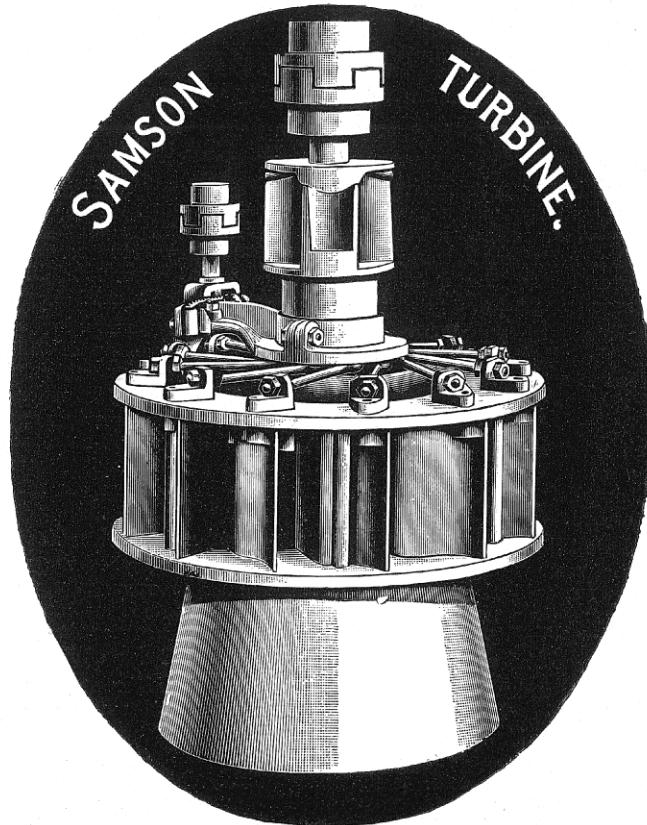
Dams Water Energy...

Water Turbine Technology

COPYRIGHT SECURED, and TRADE-MARK REGISTERED
1893, BY

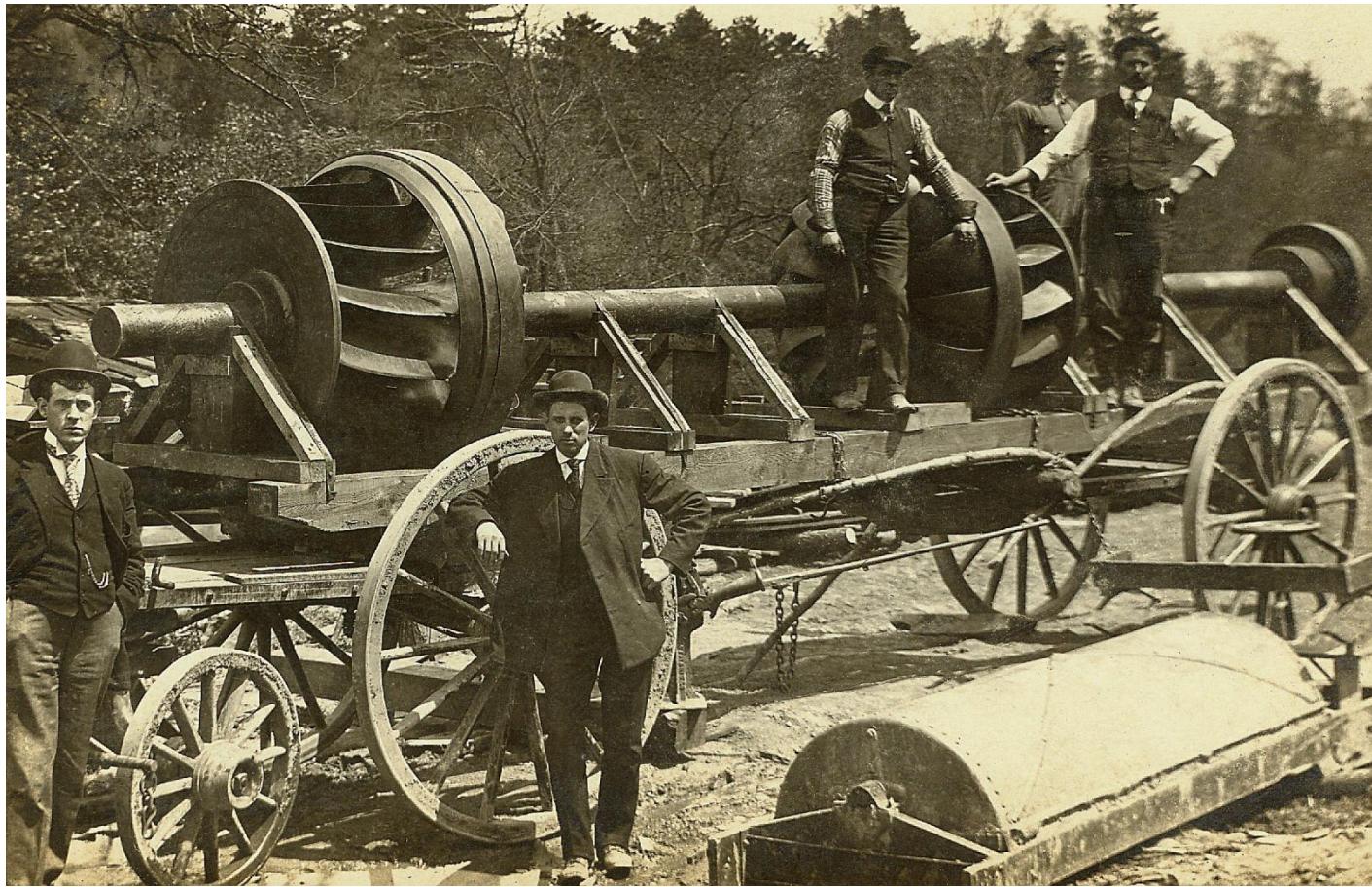


JAMES LEFFEL & CO., SPRINGFIELD, OHIO.



Dams Water Energy...

Water Turbine Technology



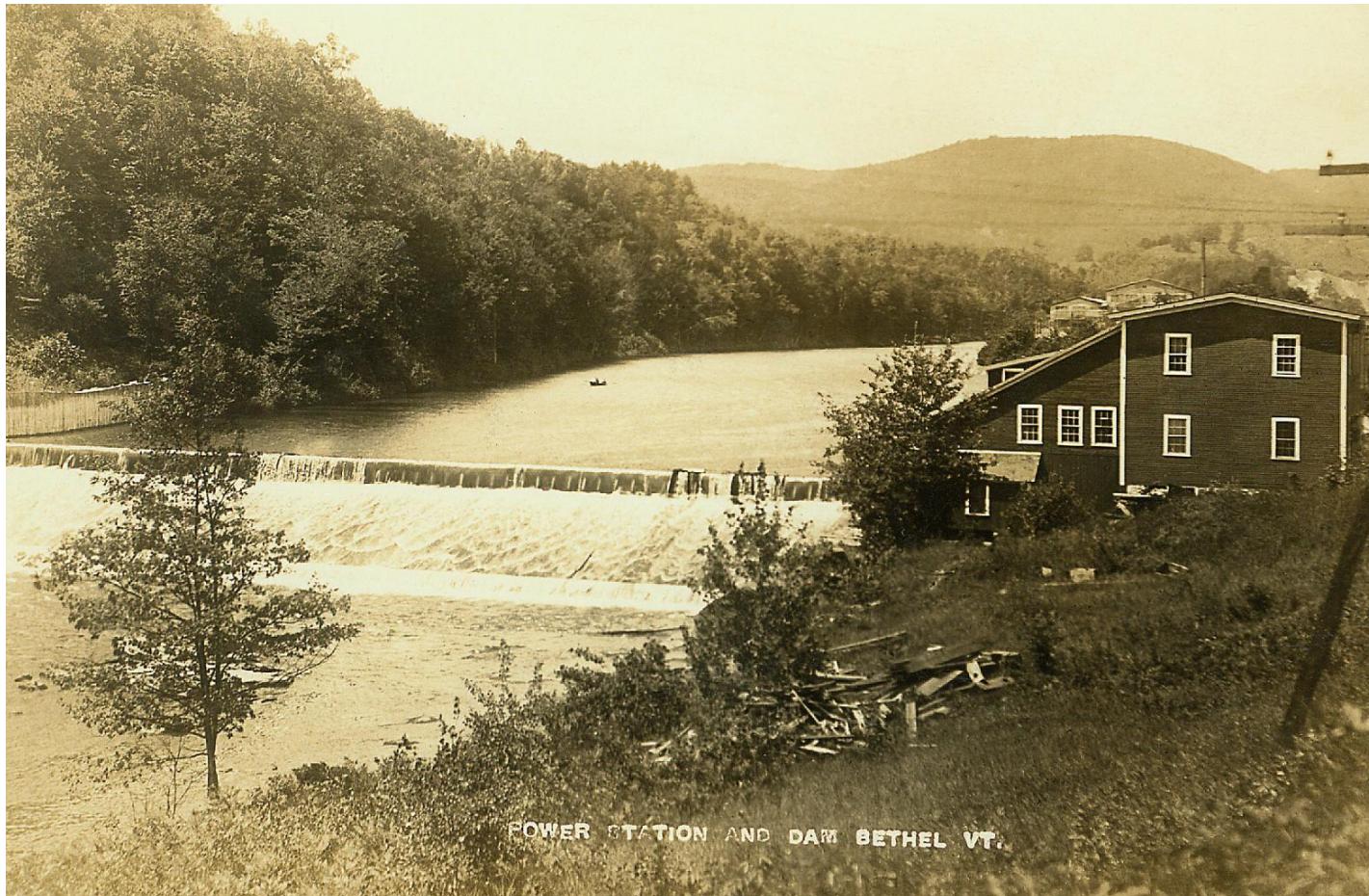
Dams Water Energy...

Water Turbine Technology



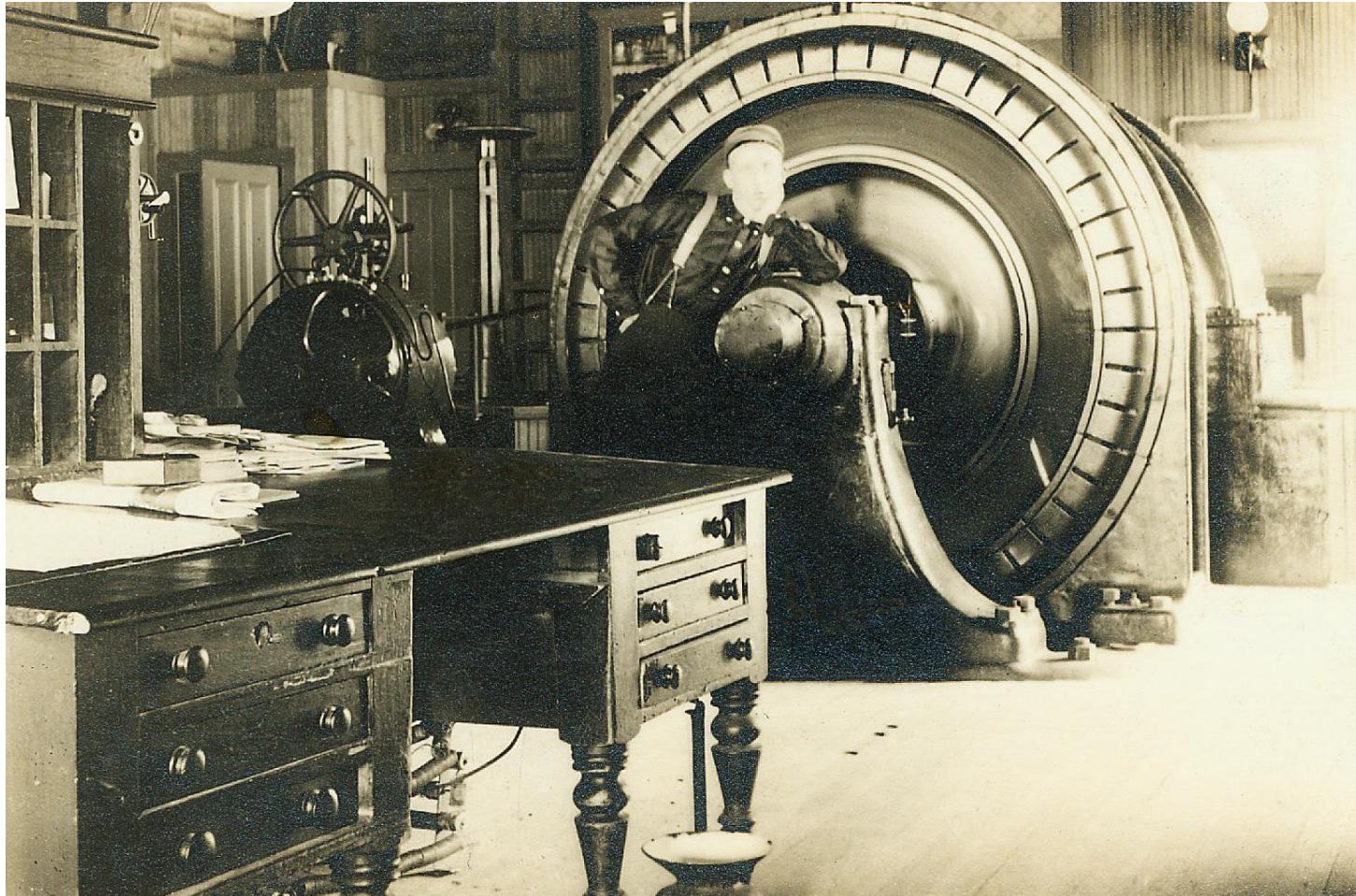
Dams Water Energy...

Hydroelectric Power – 1880s onward...



Dams Water Energy...

Hydroelectric Power – Pastoral Scale



Dams Water Energy...

Hydroelectric Power - Industrial

Dam and Power House. Pelzer, S. C.



Cotton Mill No. 4. Pelzer, S. C.



Weave Room, Mill No. 4. Pelzer, S. C.



Dams Water Energy...

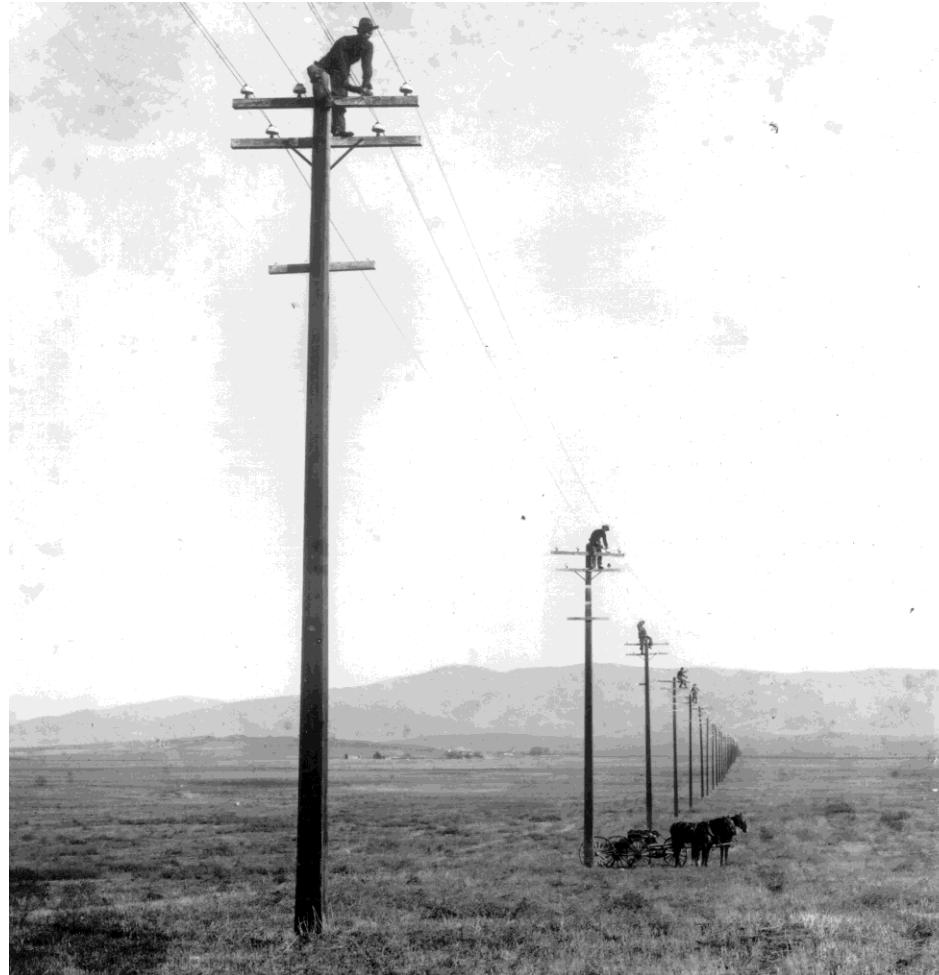
Hydroelectricity & Regional Networks

San Joaquin Electric Company 1895



Dams Water Energy...

1896 - Fresno's 34 mile, 11KV AC line



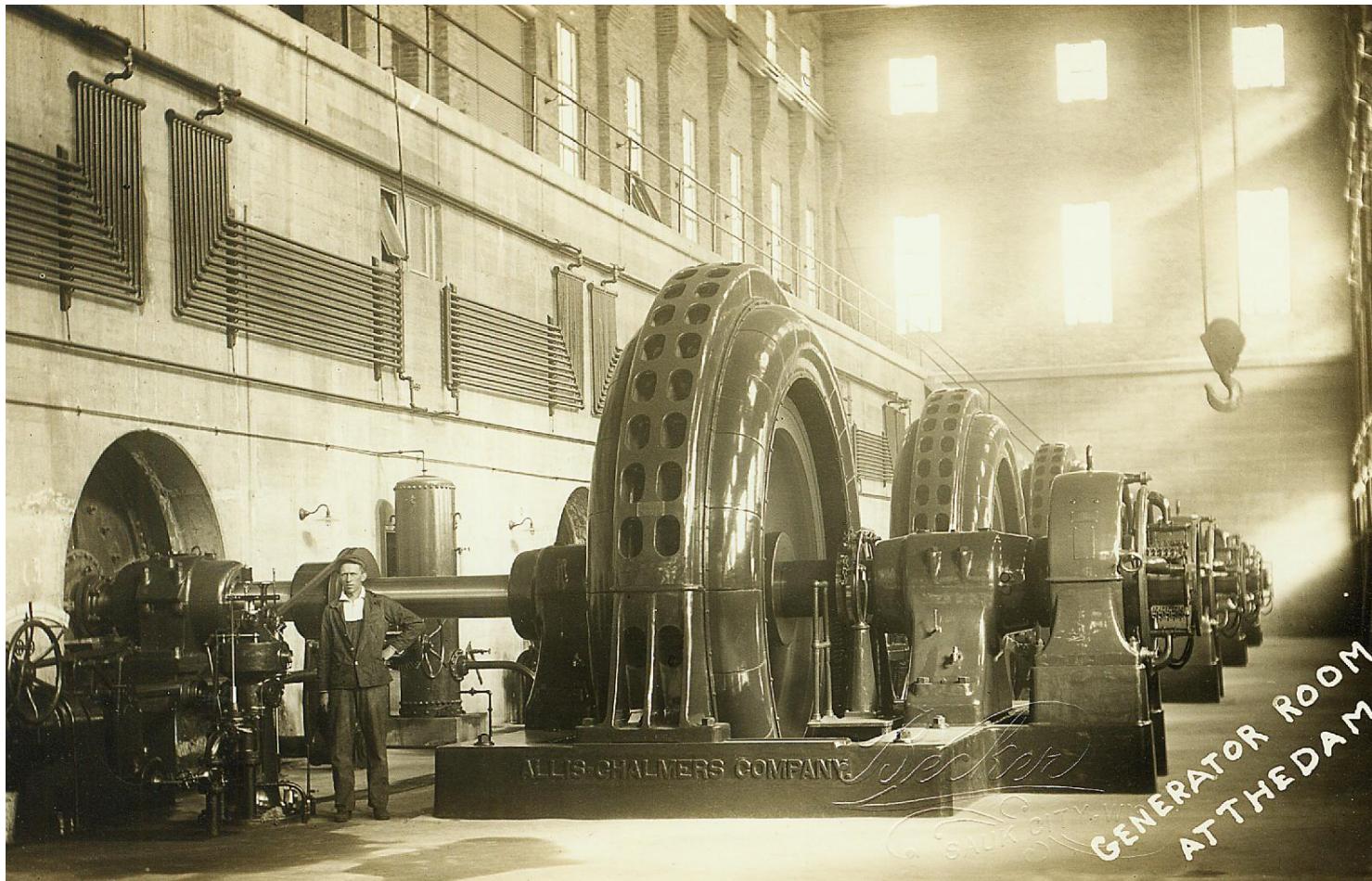
Dams Water Energy...

Prairie du Sac Wisconsin - 1914



Dams Water Energy...

Prairie du Sac Wisconsin - 1914



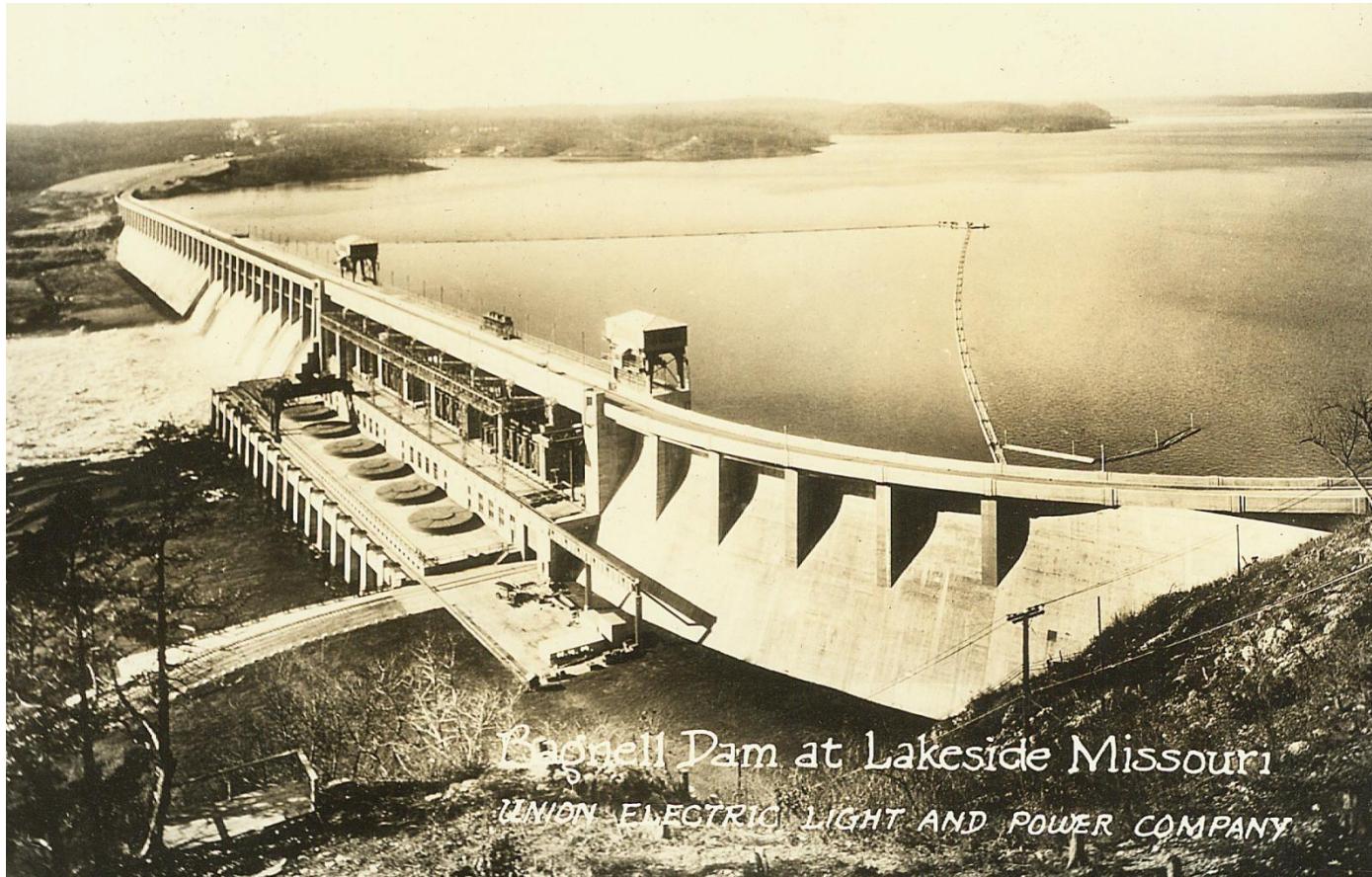
Dams Water Energy...

Great Falls Montana 1915



Dams Water Energy...

Bagnell Dam Missouri 1930 (Stone & Webster)



Dams Water Energy...

“Multiple Uses” of Dams

Navigation/Canals

Logging

Irrigation

Mining

Municipal Water Supply

Flood Control

Recreation

Dams Water Energy...

“Multi-Purpose” Dams
can be used for many purposes,
but “multi-use” limits operational efficiency
of any single use

For example...

Storing water for seasonal irrigation
conflicts with releasing water to maximize
the value of hydroelectric power
generation

Dams Water Energy...

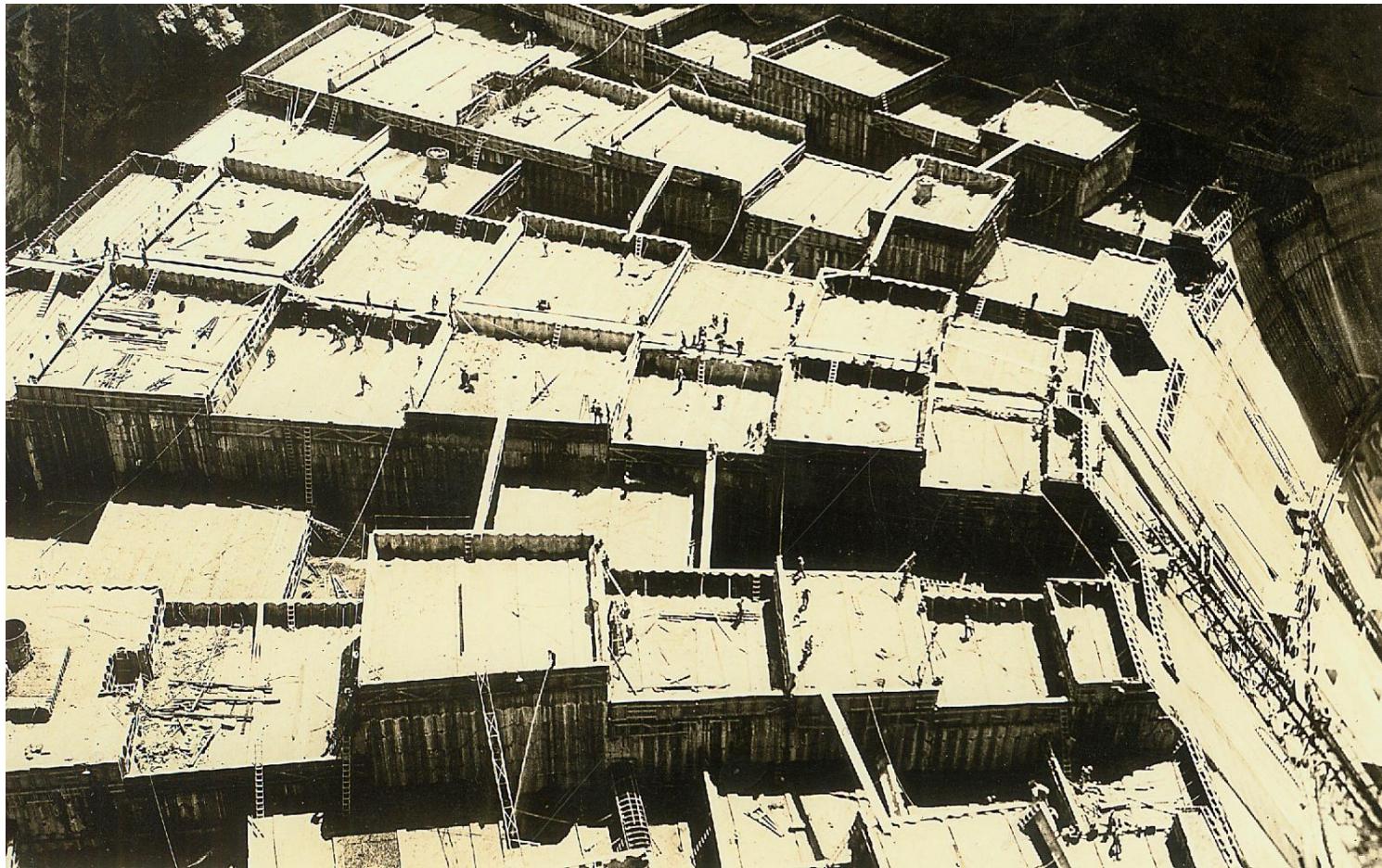
New Deal Dams

**The Ascendance of “Multi-Purpose” dams
as Monuments of Civic Enterprise**

**Human Accomplishment in the Face of
Economic Hardship...**

Dams Water Energy...

Boulder/Hoover Dam 1931-35



Dams Water Energy...

FDR and Dam Politics



Infrastructure Politics...

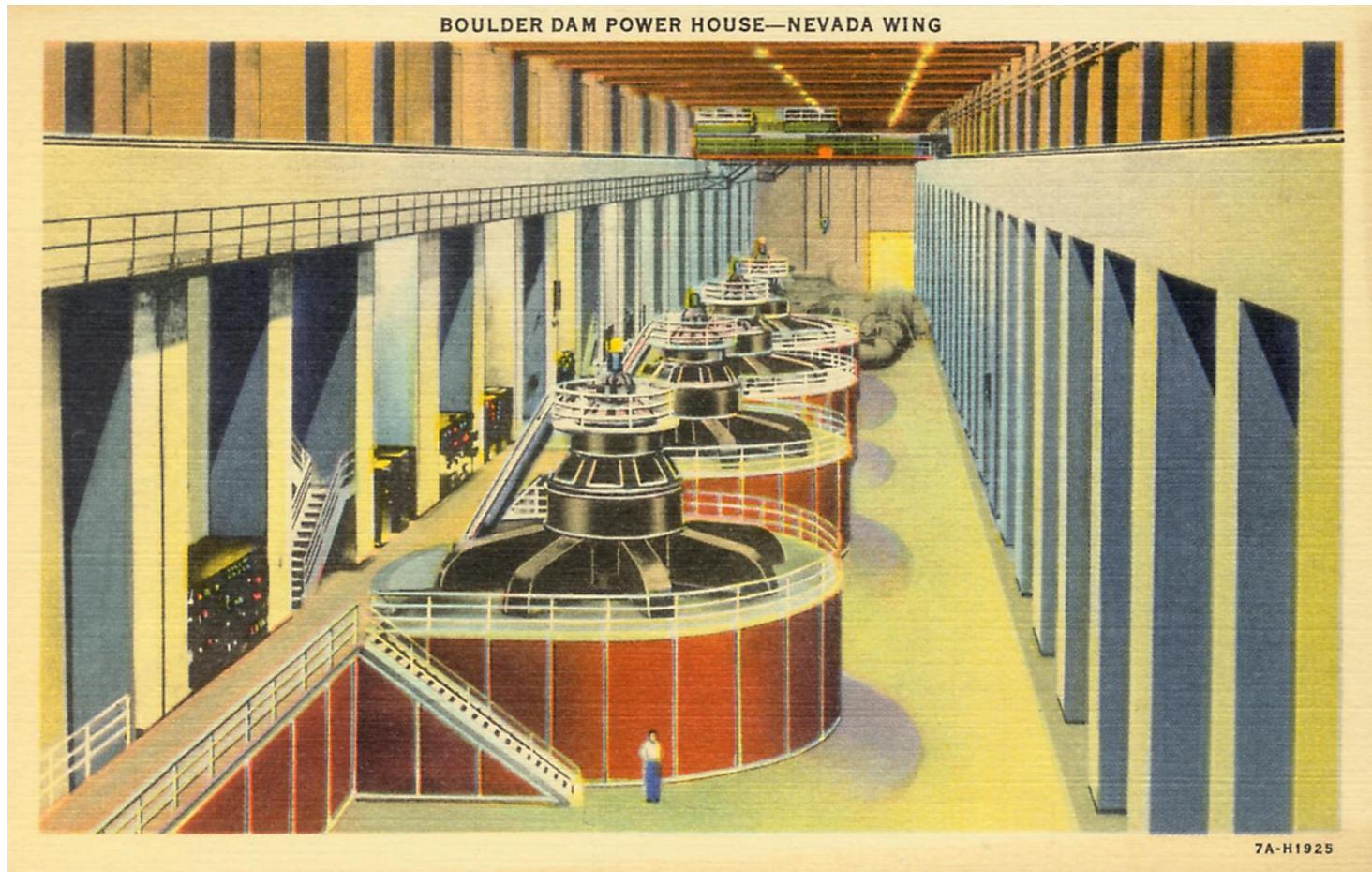
Pres. Obama at Hoover Dam Oct 2, 2012

Who built that?



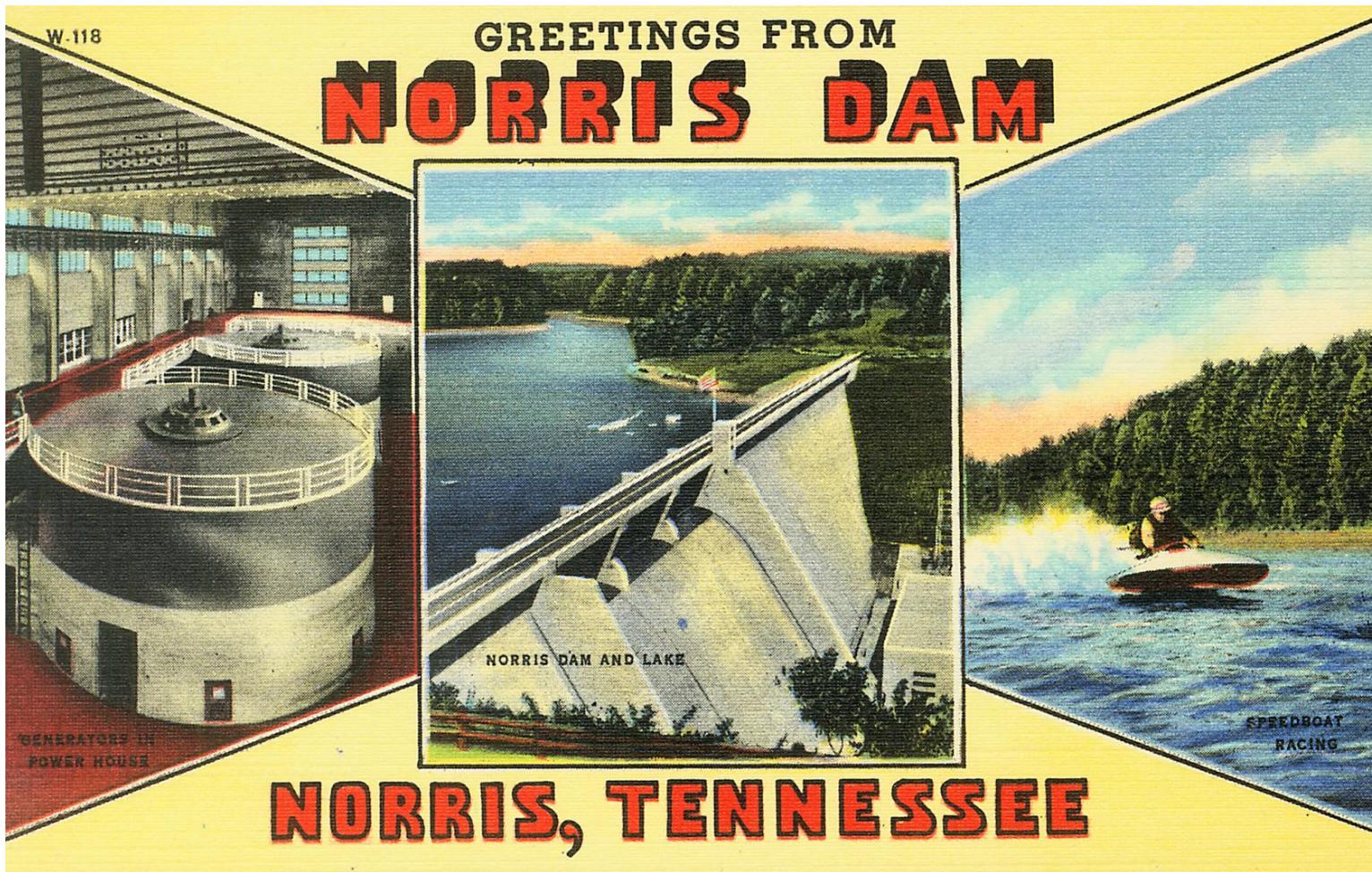
Dams Water Energy...

~2000 MW capacity Boulder/Hoover Dam



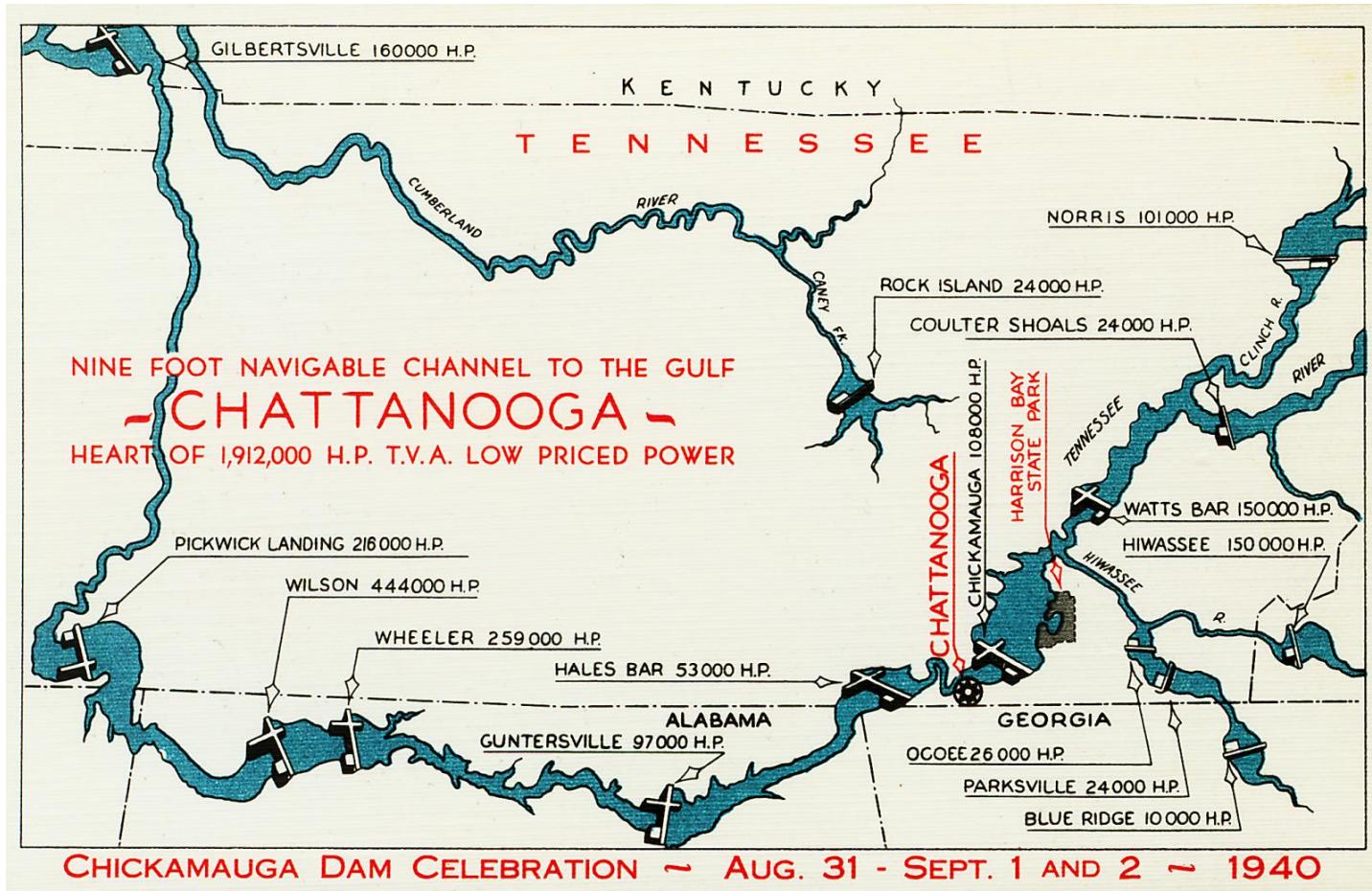
Dams Water Energy...

TVA – Norris Dam 1933-36



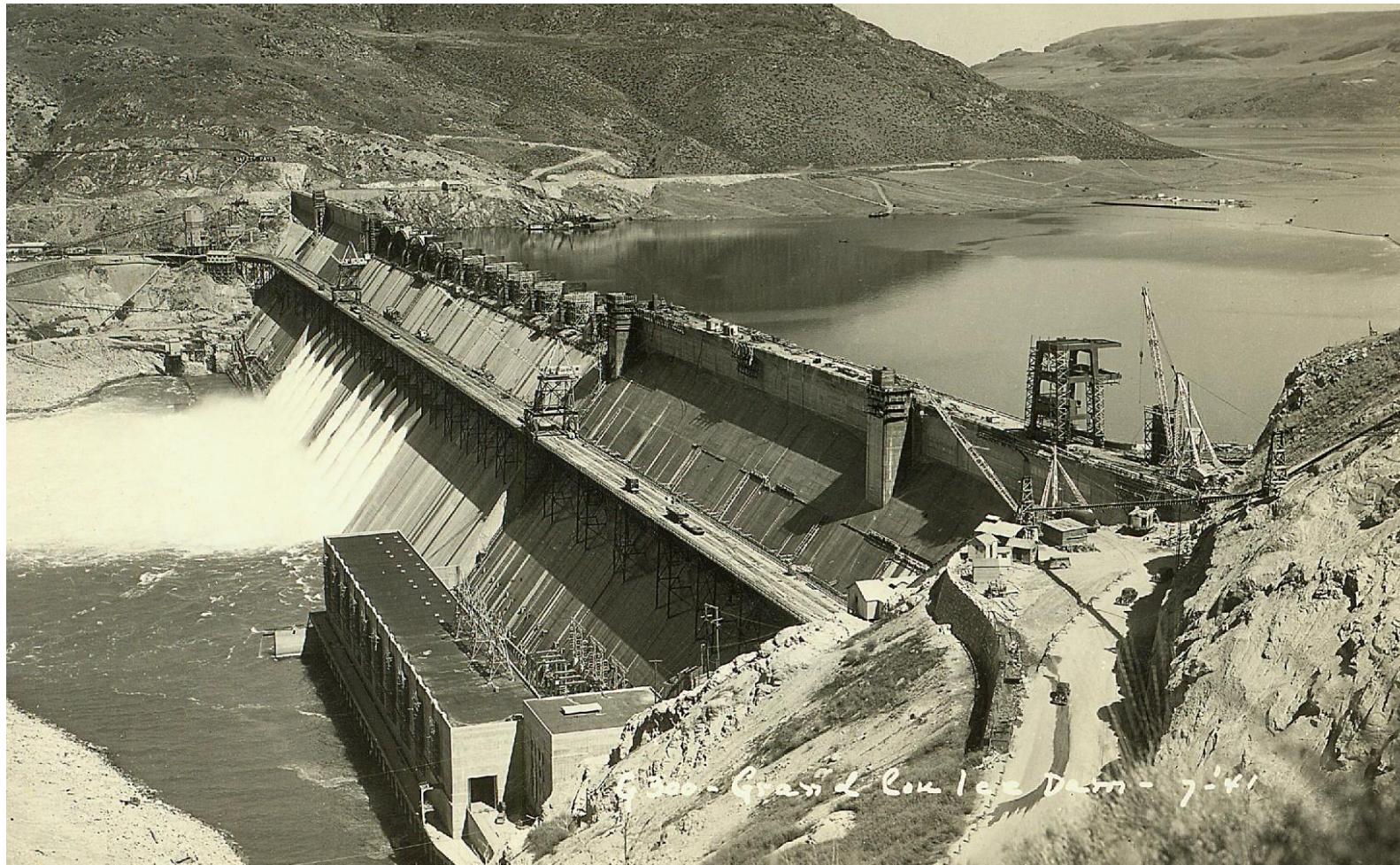
Dams Water Energy...

TVA River Basin Development



Dams Water Energy...

Grand Coulee Dam - 1933-42



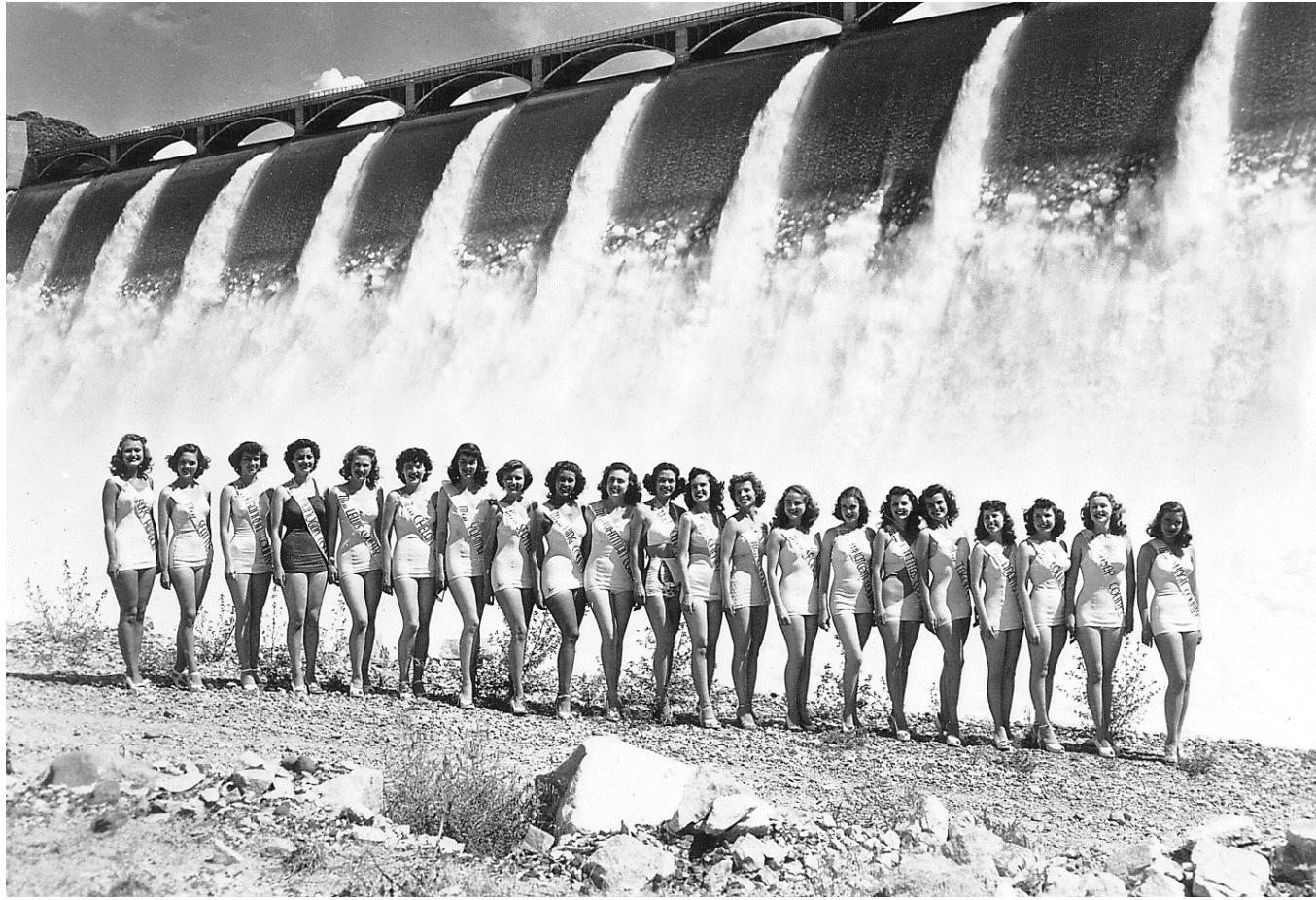
Dams Water Energy...

Grand Coulee Dam – American Icon



Dams Water Energy...

Grand Coulee Dam – American Icon!



Dams Water Energy...

Dams and Sustainability:

Scenic Values

Fish

Cultural Values

Ecological Values

A Counter Narrative...

Dam Opposition

Hetch Hetchy – Yosemite Natl. Park Beautiful Valley or Ideal Reservoir Site?

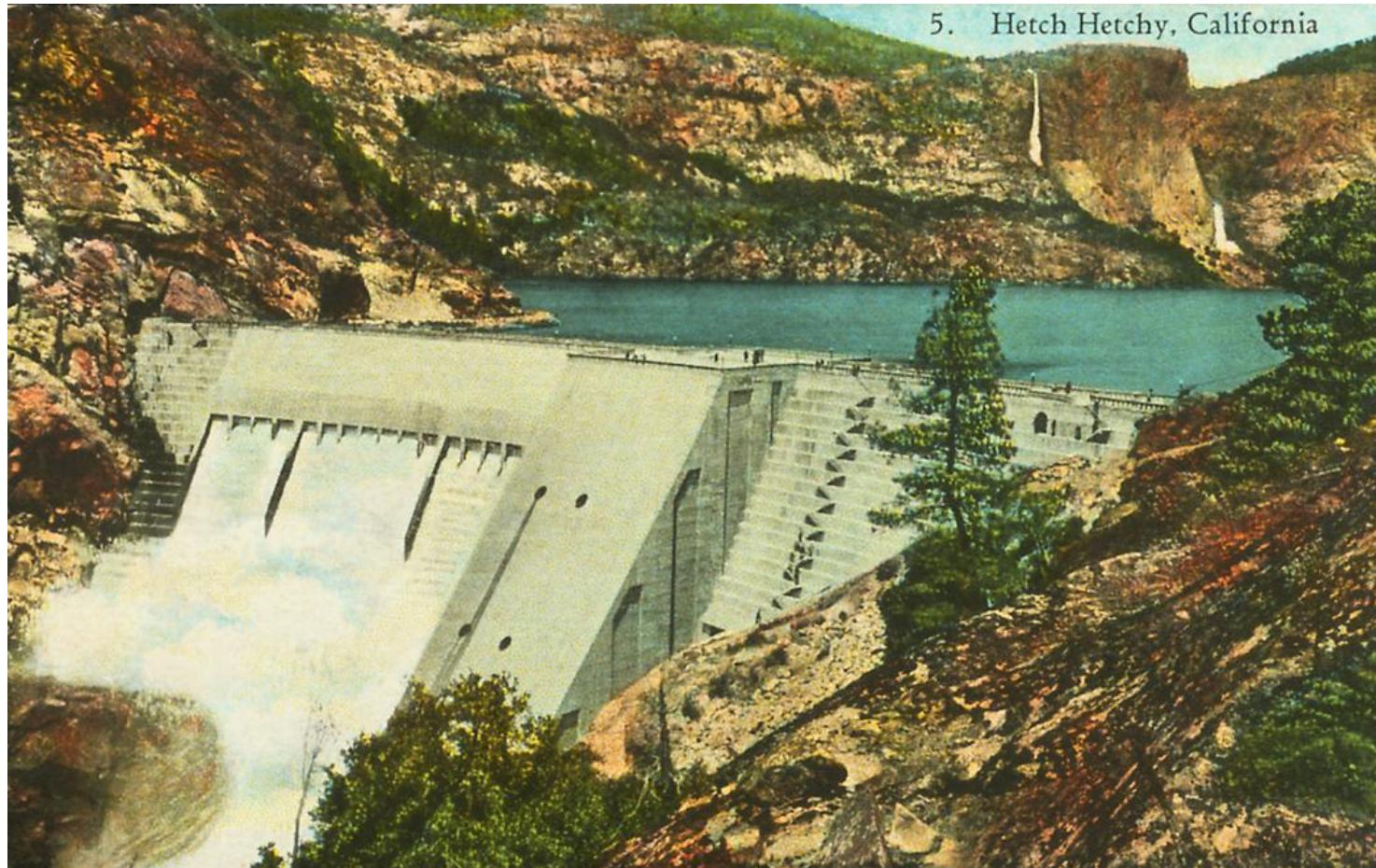


Hetch Hetchy Valley, Tuolumne County, California.

Pub. by Manuel Azevedo, Tuolumne, California.

Dam Opposition

Hetch Hetchy Dam 1923

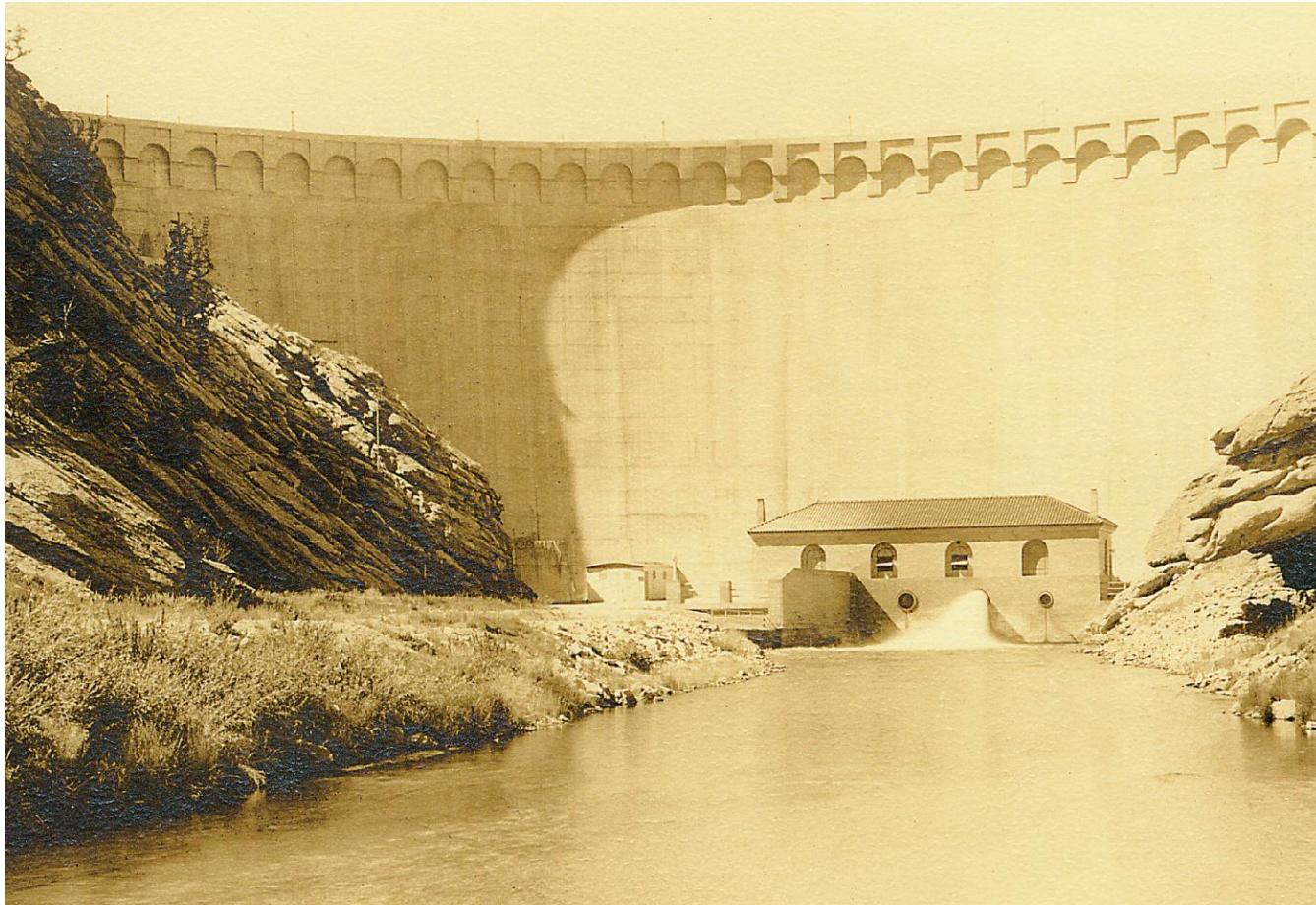


Dam Opposition... **Hetch Hetchy and Hydroelectric Power**



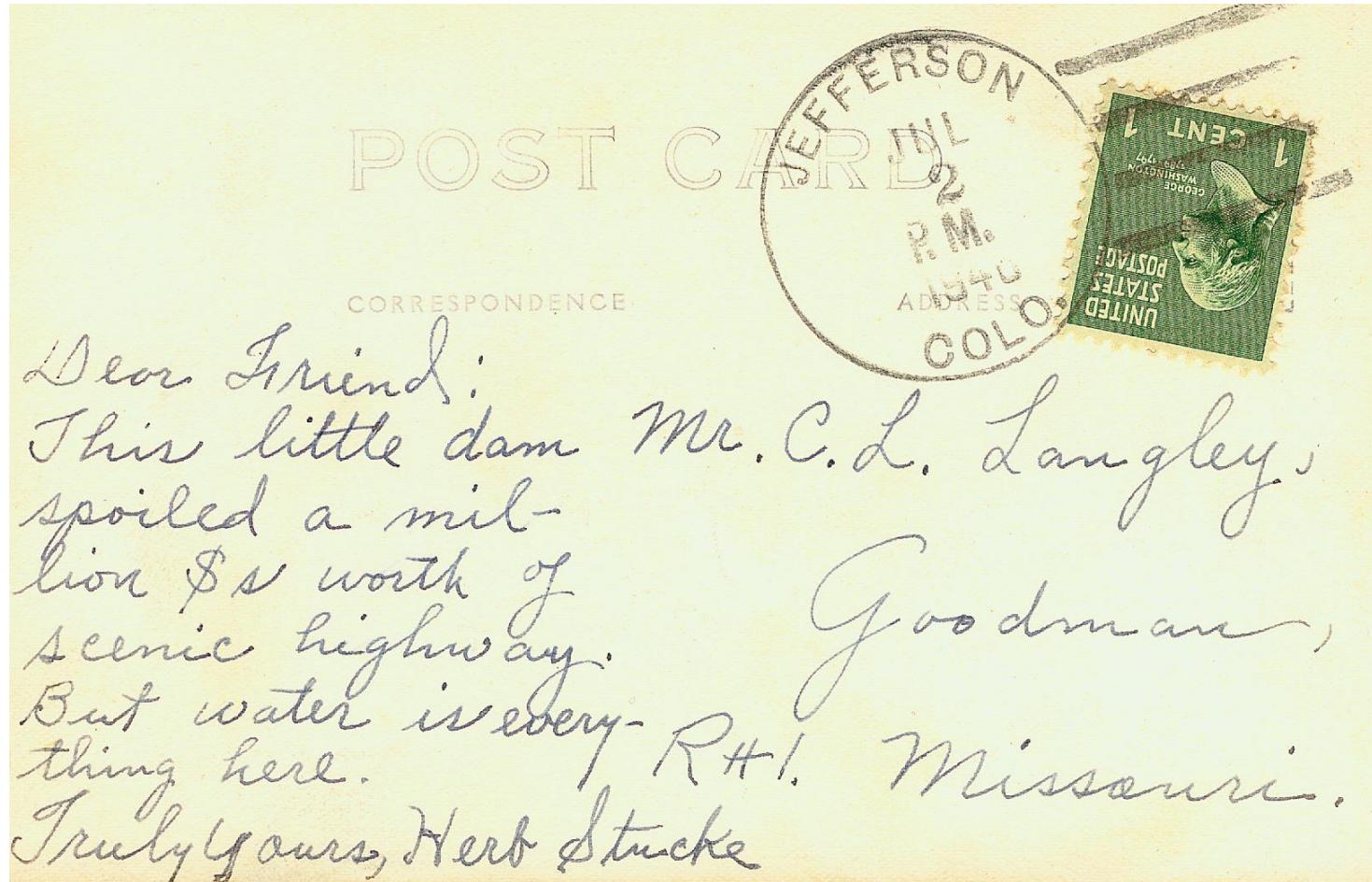
Dam Opposition...

Eleven Mile Dam - Denver Water Supply



Dam Opposition...

Eleven Mile Dam - Denver Water Supply

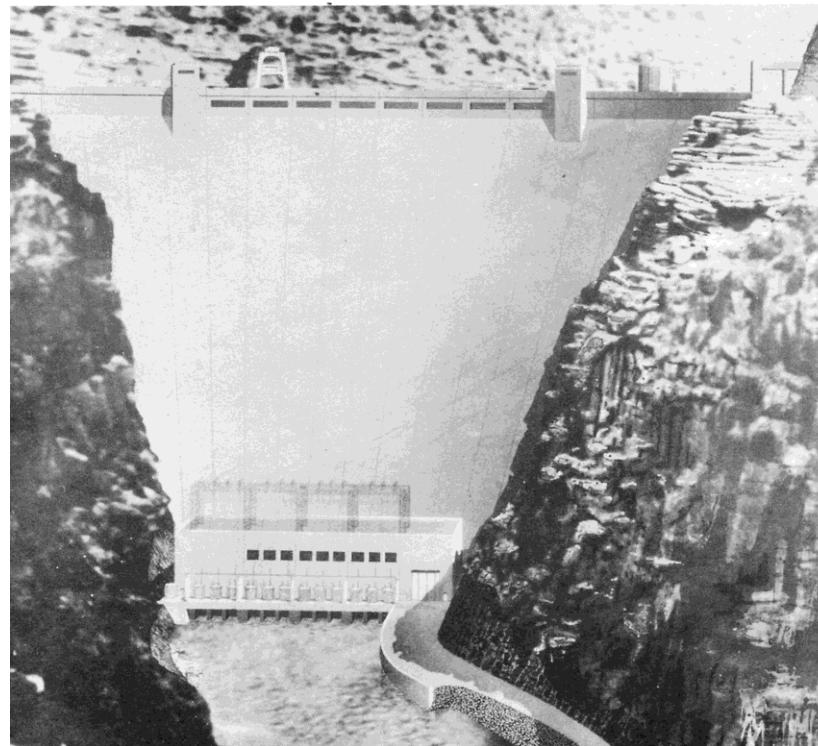


Dam Opposition...

1940s: A Dam in Dinosaur Natl. Monument?

Echo Park Dam

...Man and Nature Cooperate



Dam Opposition...

Echo Park Saved - 1956



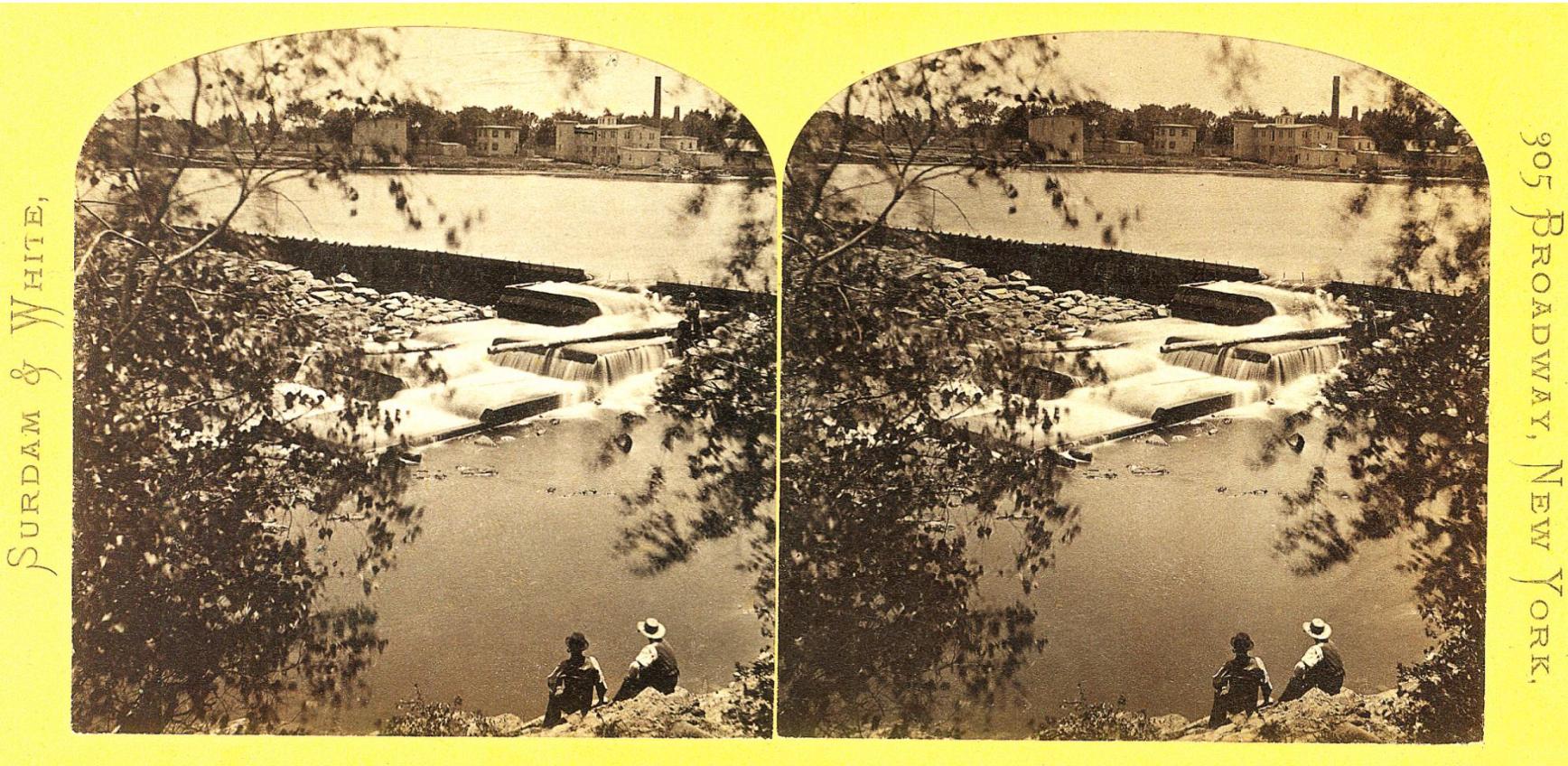
Dams and Fish...

The effect of dams on spawning fish



Dams and Fish...

Lowell: Fish vs. Power



SURDAM & WHITE,

305 BROADWAY, NEW YORK,

Dams and Fish...

Fish Ladder - Wisconsin



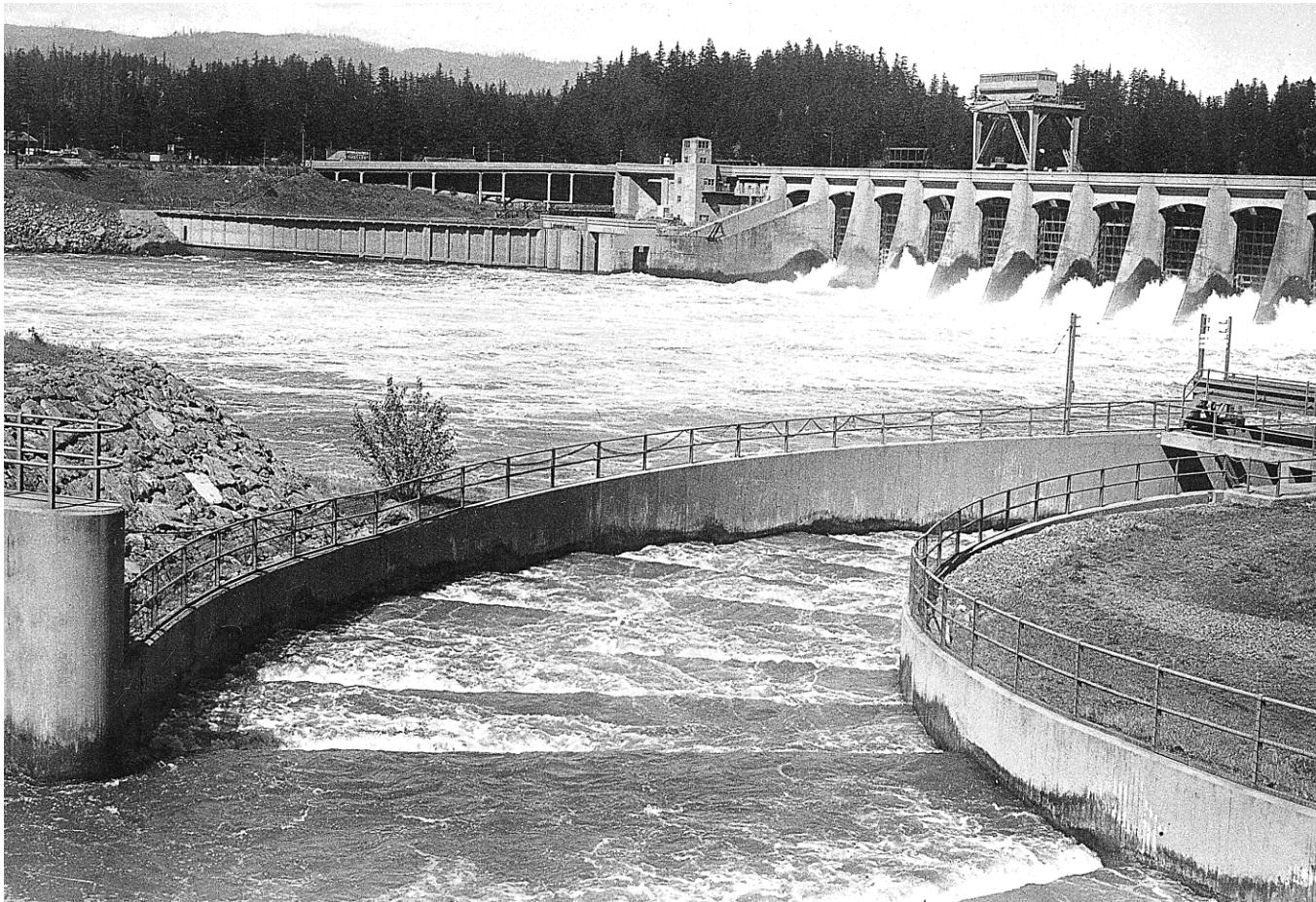
Dams and Fish...

Fish Ladder – Pacific Northwest



Dams and Fish...

Bonneville Dam Fishladders



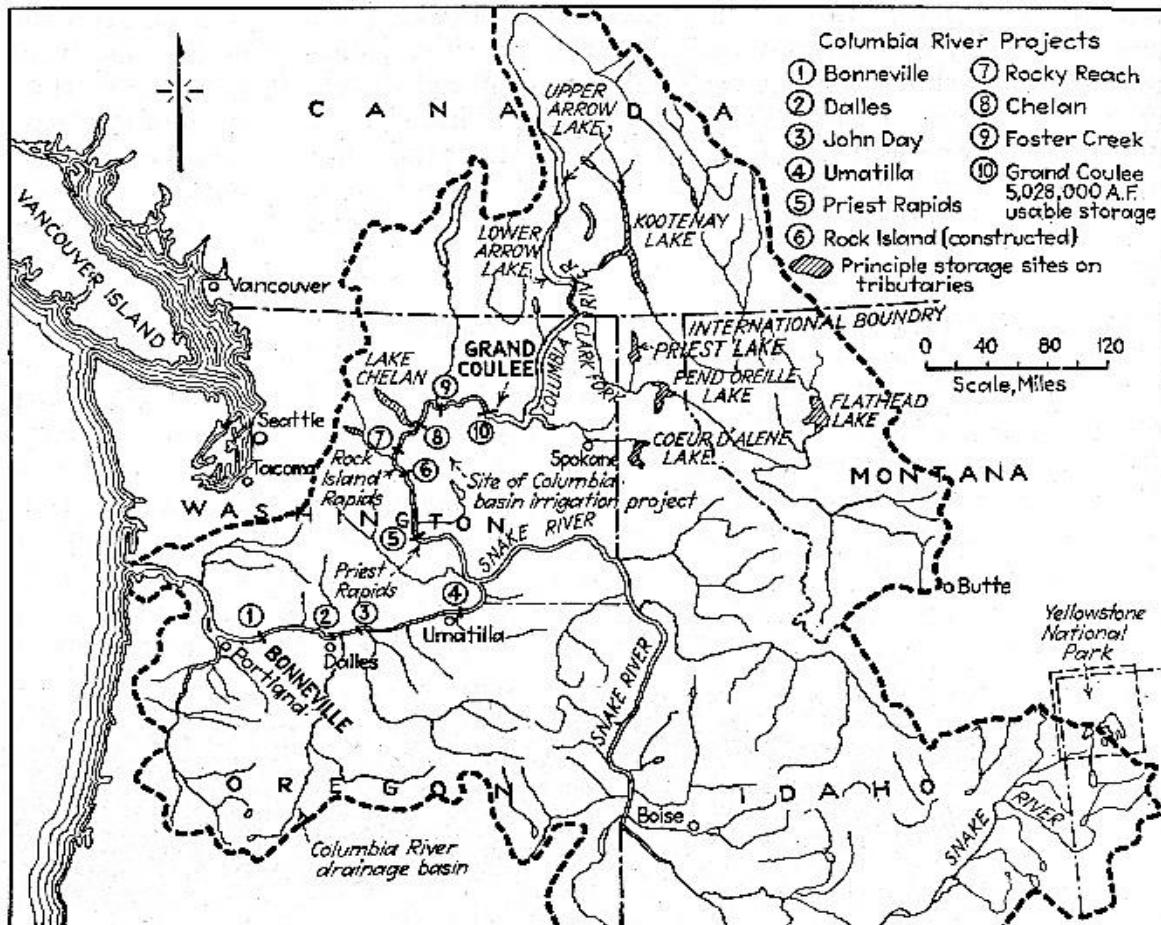
Dams and Fish...

Bonneville Dam fishladders



Dams and Fish...

Columbia River: Filling in the Staircase...



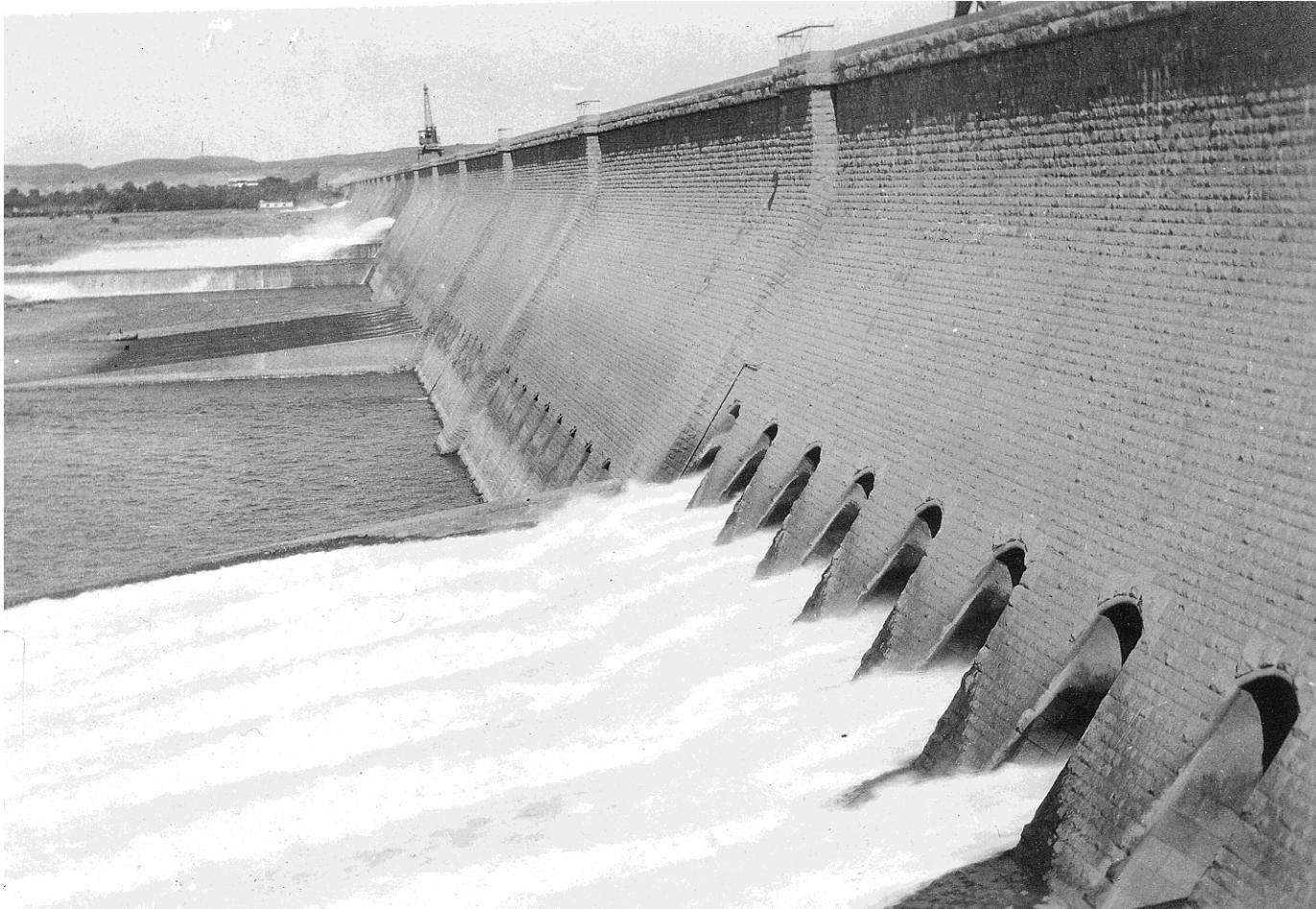
Dams and Fish...

(Literally) Diminishing returns...



Dams and Culture...

The Aswan Dam 1908



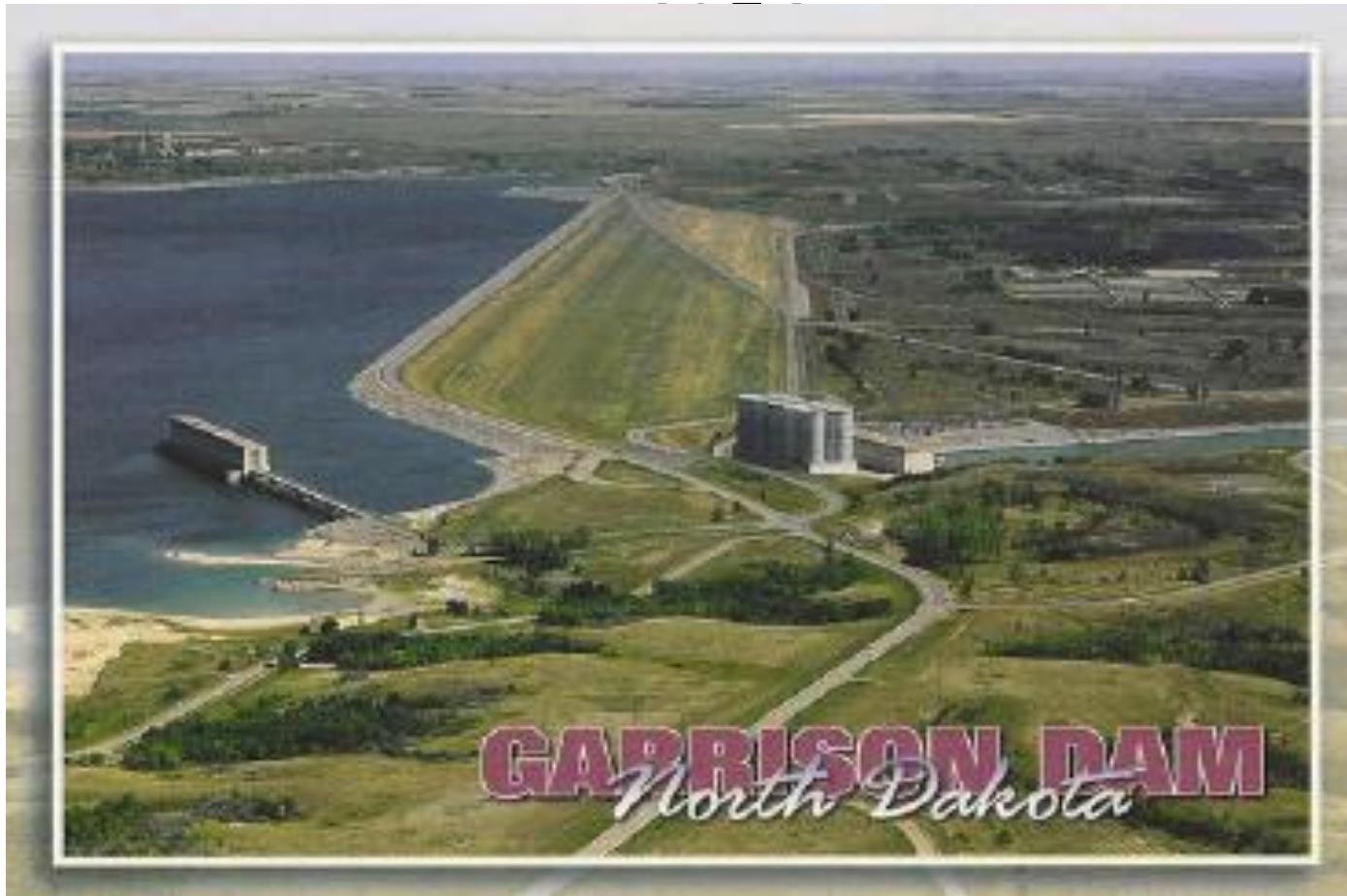
Dams and Culture...

Inundation of the Upper Nile basin



Dams and Culture...

Garrison Dam across the Missouri River



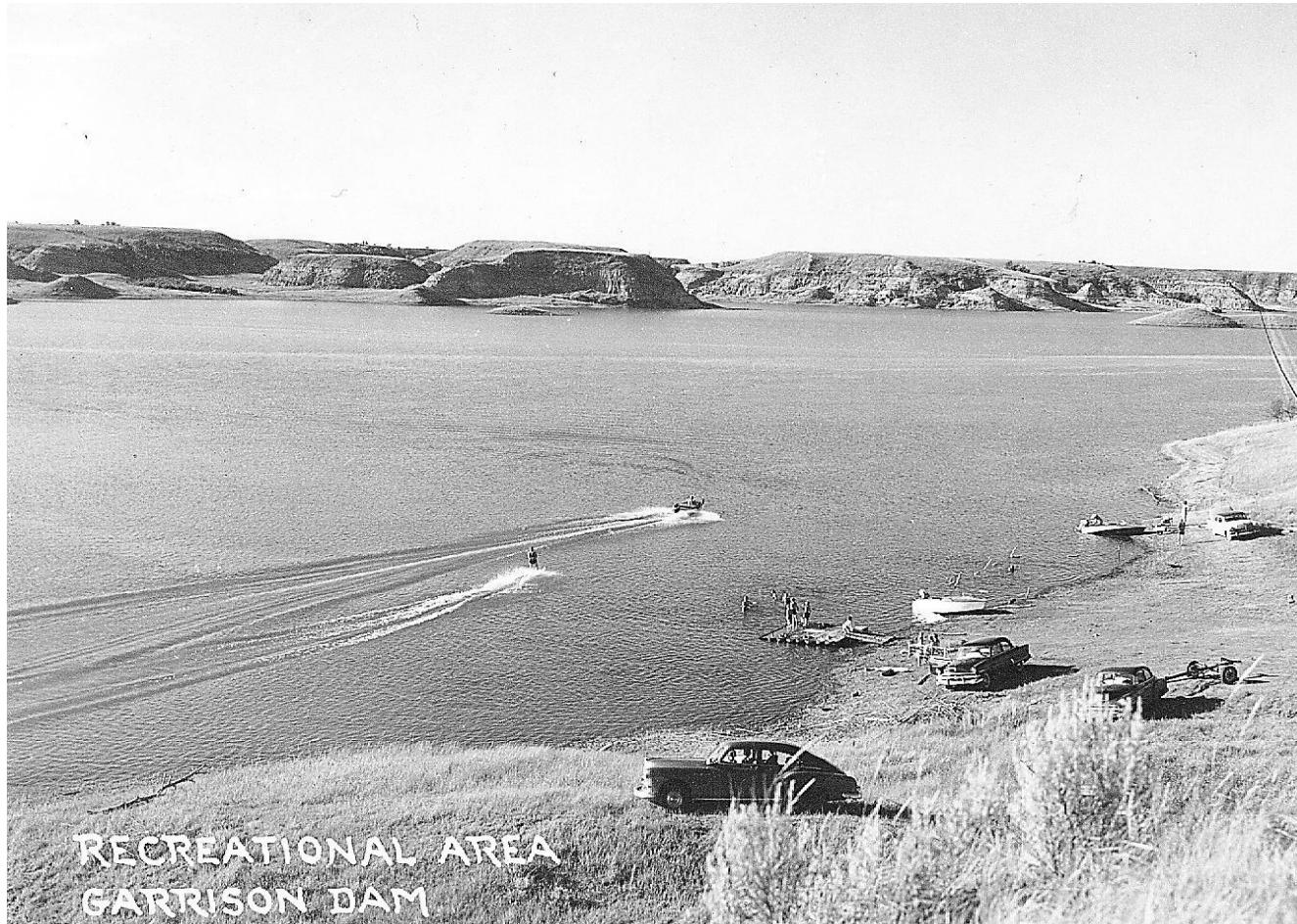
Dams and Culture...

Garrison Dam floods the Three Affiliated Tribes



Dams and Culture...

“Not for Man, but for Some Men...”



RECREATIONAL AREA
GARRISON DAM

Dams and Culture...

Columbia River: Celilo Falls



Dams and Culture...

Dalles Dam Drowns Celilo Falls 1957



Dam Opposition...

“Grand Canyon Dams” - 1963-68



Dam Opposition...

Operational Issues – Glen Canyon Dam



Dam Opposition...

1980s - Glen Canyon Dam and River “Surge”



Dam Opposition...

Humpback Chub & Grand Canyon Ecology



The Dam Removal Movement

Dams and Ecology

Cultural Sustainability

&

Environmental Sustainability

The Dam Removal Movement

The Dam Removal Movement

1990s - An Era of Cheap Energy



The Dam Removal Movement

Small Hydropower Loses \$\$\$ Value

In a world of 1,000+ MW power plants, why worry about 3 MW facilities?



The Dam Removal Movement

Edwards Dam – Kennebec River, Maine



The Dam Removal Movement

Edwards Dam – Removed 1998



The Dam Removal Movement

FERC Approved – In Stream Use



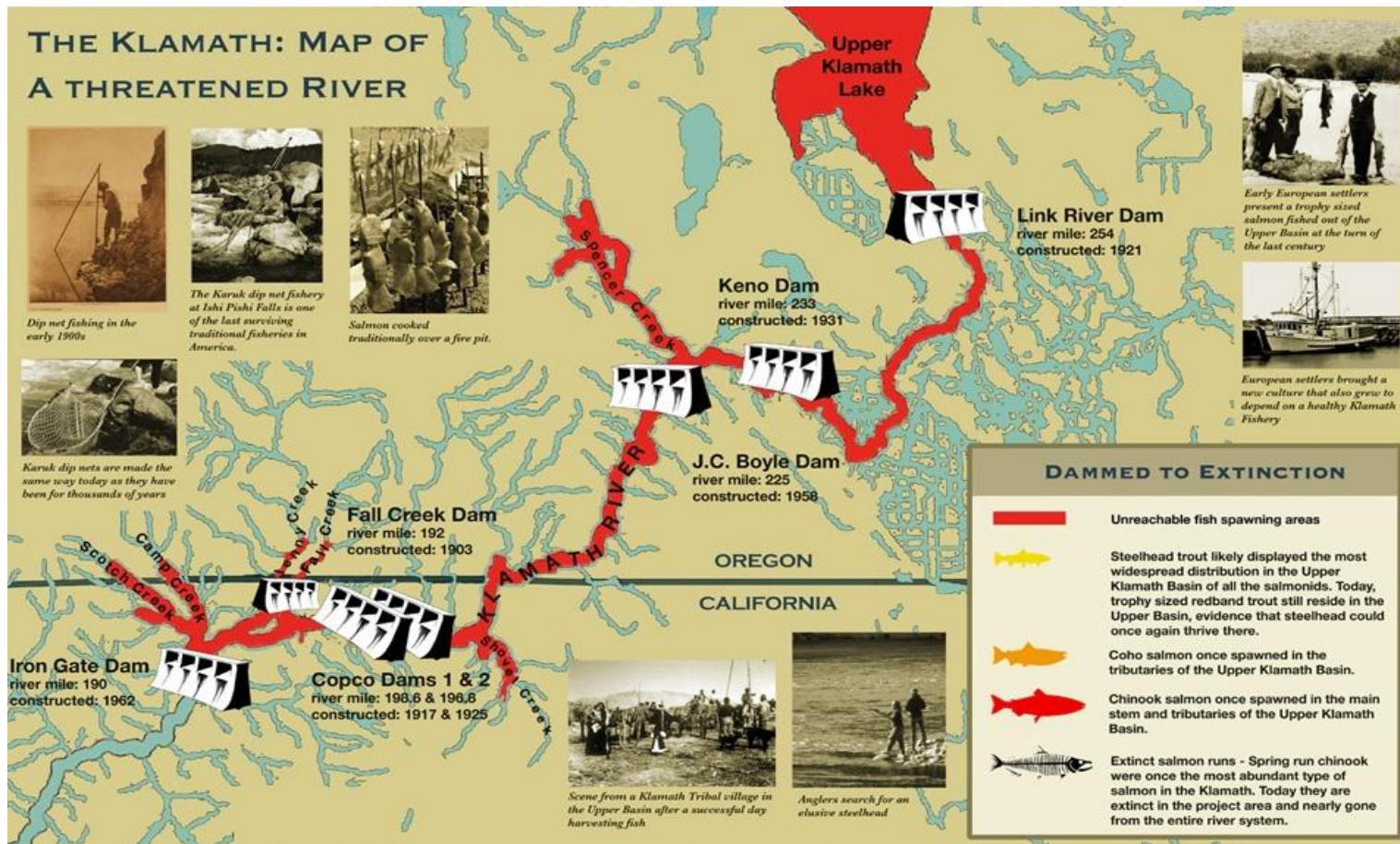
The Dam Removal Movement

Raising the Stakes: Marmot Dam - Avg. 13MW



Dam Removal Today...

Copco's Klamath Hydropower Dams



Dam Removal Today...

The Klamath River

263 miles long – Avg. discharge 17,000 cfs



Dam Removal Today...

Copco Dam #1 (1918)



Dam Removal Today...

The Power Capacity of the COPCO Dams

JC Boyle Dam: ~80 MW

Copco 1 Dam: ~20 MW

Copco 2 Dam: ~20 MW

Irongate Dam: ~17 MW

TOTAL: ~137 Megawatts

Dam Removal Today...

Power Supply Capacity of California:
~53,000 MW

Available Capacity: ~47,000 MW (give or take)

137 MW seems minuscule in this light

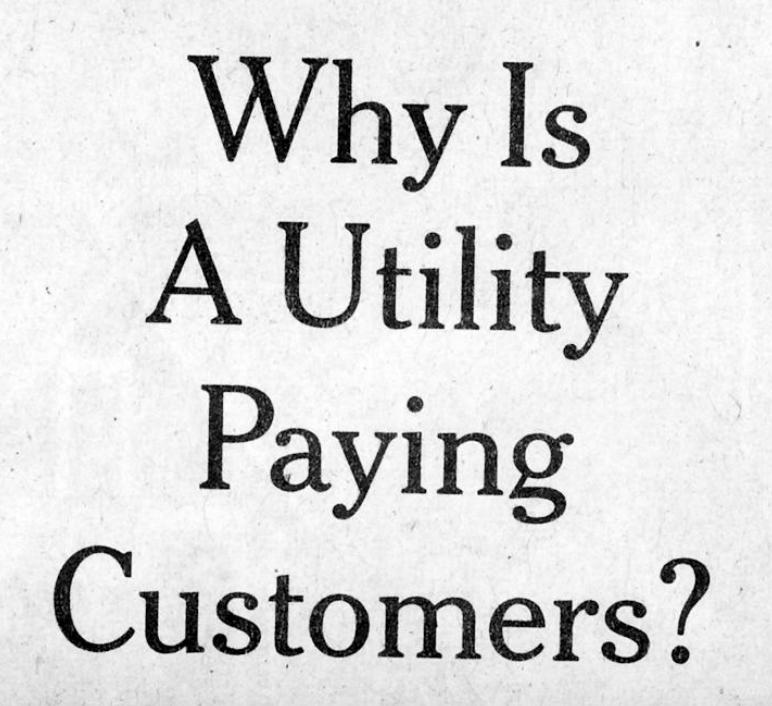
But regional power demand is also large
When demand surges and blackouts loom

137 MW is far from insignificant

Power Grid Realities...

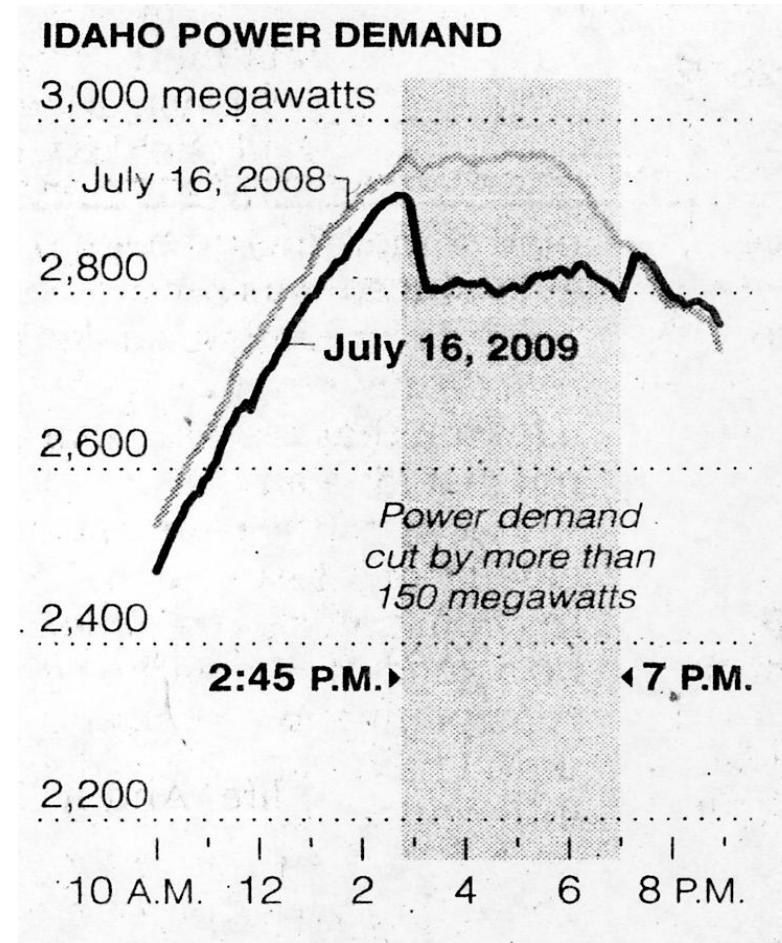
A Context: Idaho Power Company's Program to Meet Peak Load

NYTimes Business section 1/24/2010



Why Is
A Utility
Paying
Customers?

Power Grid Realities... Paying to Meet Peak Load



Dams Water Energy...

Questions and Comments

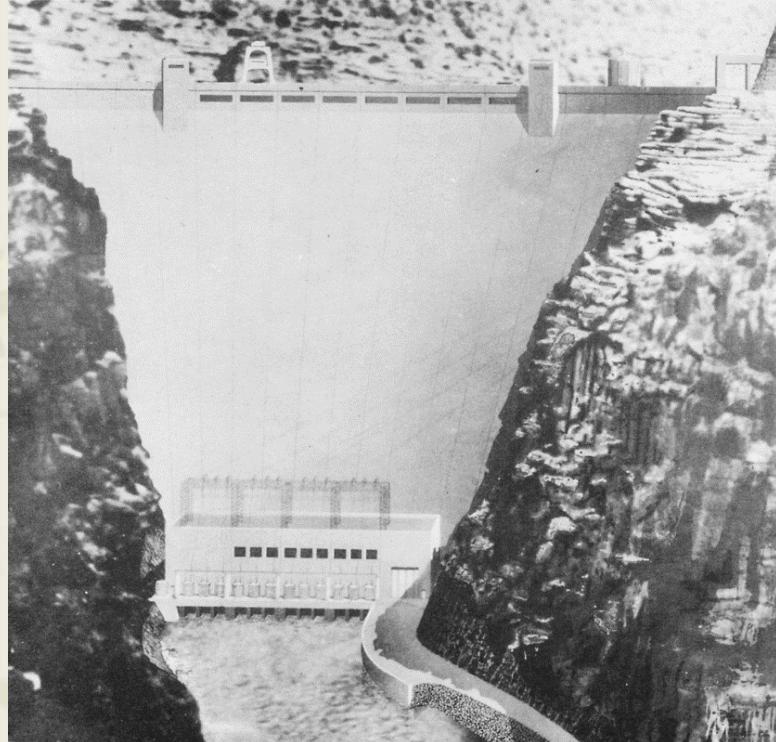






Echo Park Dam

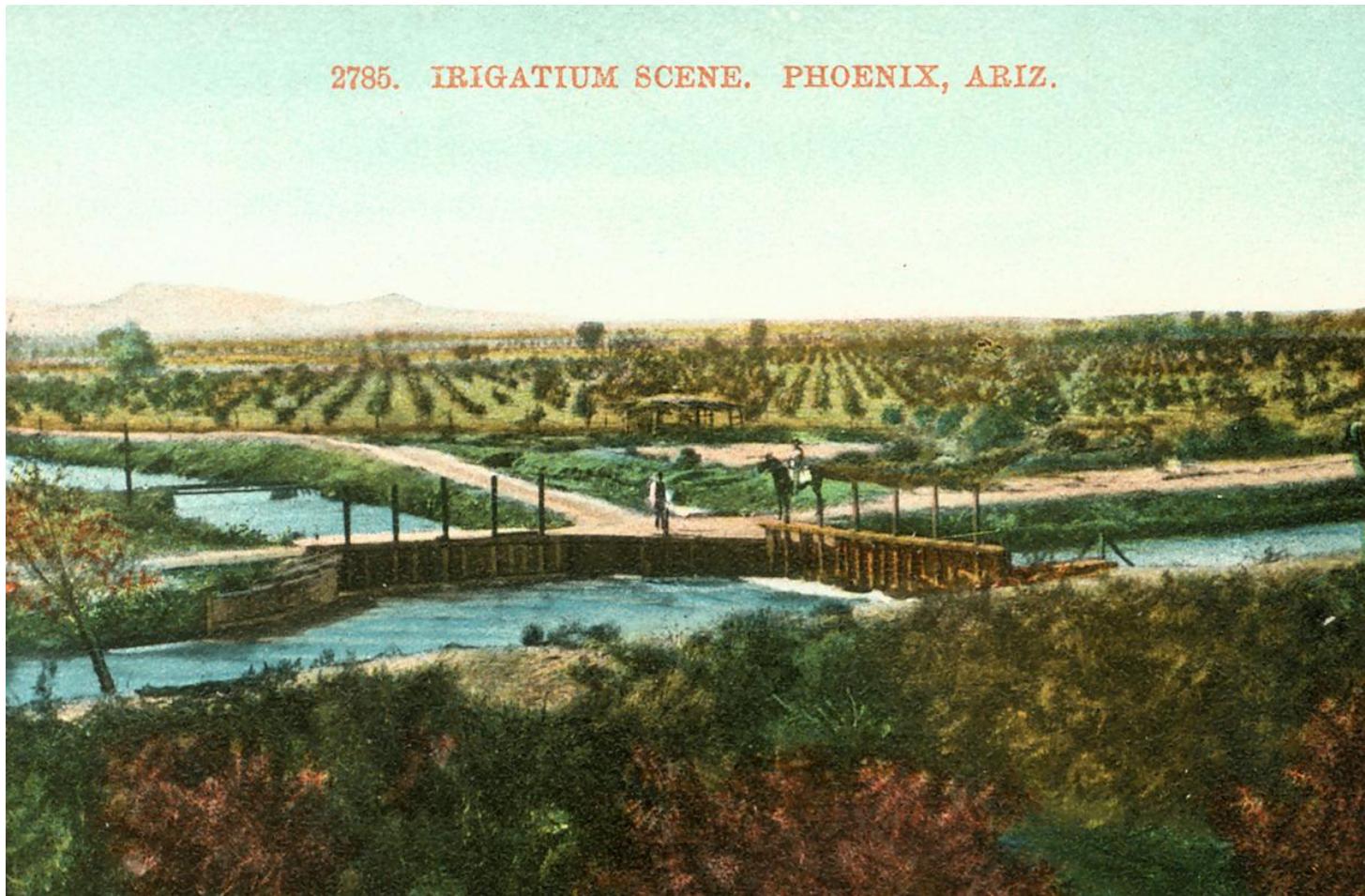
... Man and Nature Cooperate



Anti-Dam Reaction – Echo Park, Dinosaur Natl. Mon.
1948-1956

Dam (History) and the Environment...

Irrigation: Making the Desert Bloom



Dams and the Environment...

Britain's Lake District controversy 1870s **Lake Thirlmere as municipal reservoir**



Dams and Fish...

The effect of dams on spawning fish



Dams and Culture...

The Swift River Valley: Western Mass



Dams and Culture...

Boston's Quabbin Reservoir/Dam 1940



Dams and Culture...

The Quabbin Reservoir



Dams and Hydroelectricity...

SJEC's 2.5 MW Powerhouse 1896



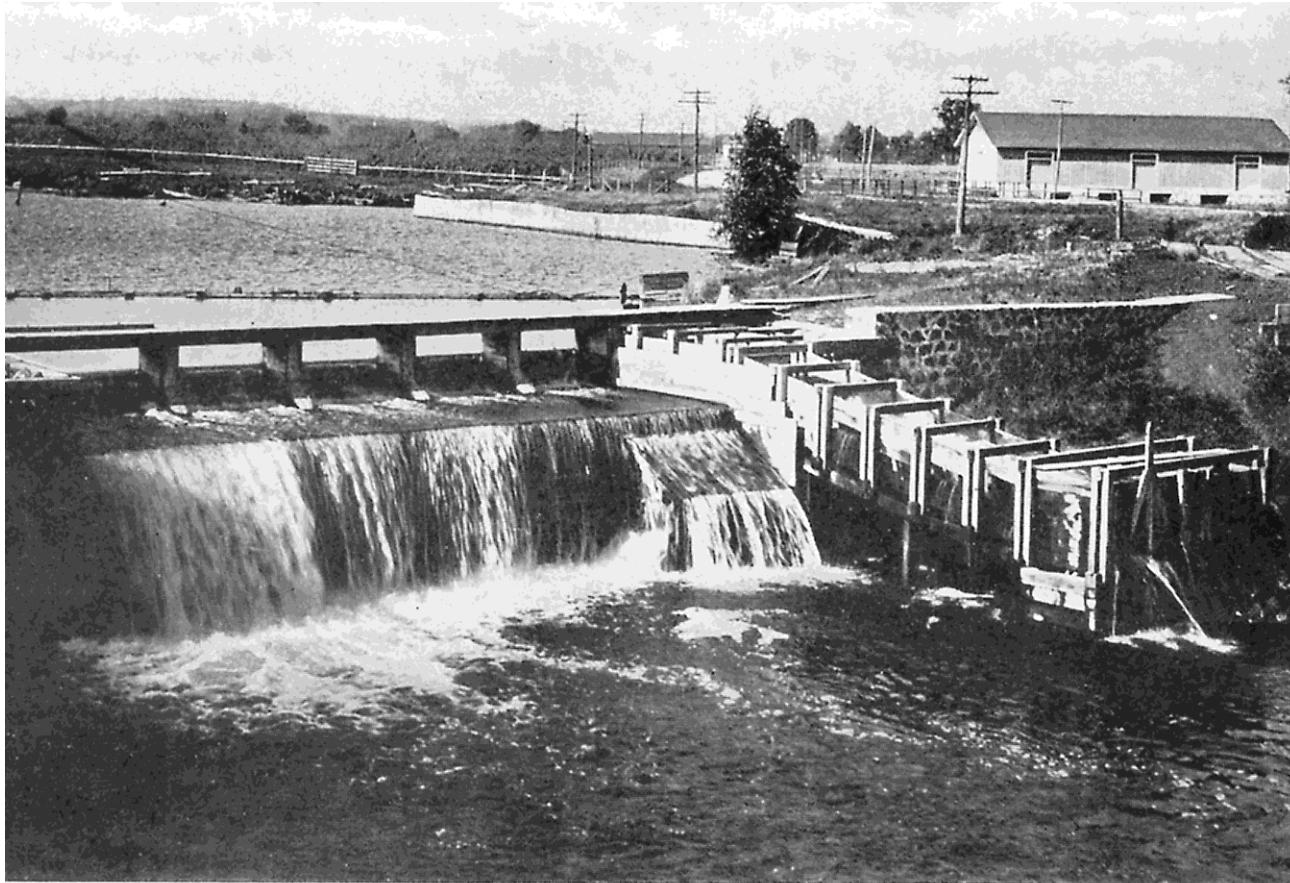
The Dam Removal Movement

Milltown Dam, Montana: 1.5 MW 1908



Dams and Fish...

Dams and fish ladders – Wisconsin



Dam and Fish Way, Weyauwega, Wis.

The Dam Removal Movement

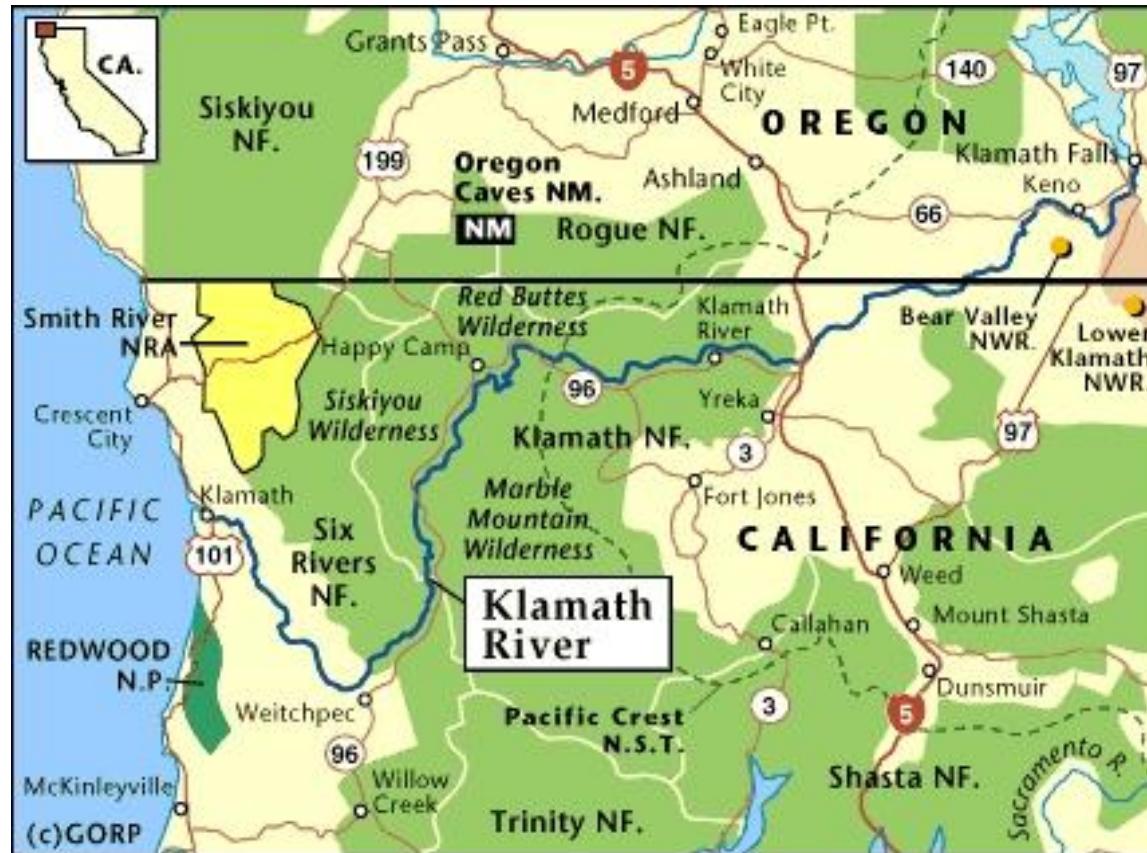
Glen Canyon Dam mitigation – 1992...



The Klamath River Watershed

The Klamath River

Along the California/Oregon borderland



The Dam Removal Movement

Grand Canyon's Humpback Chub



The Klamath and COPCO

Copco 1 designed by Hermann Schussler
engineer for SF's Crystal Springs Dam (1888)



The Klamath and COPCO

J. C. Boyle Dam (1958)



The Dam Removal Movement

Large Initiatives/Hopes: Lower Snake River



The Dam Removal Movement

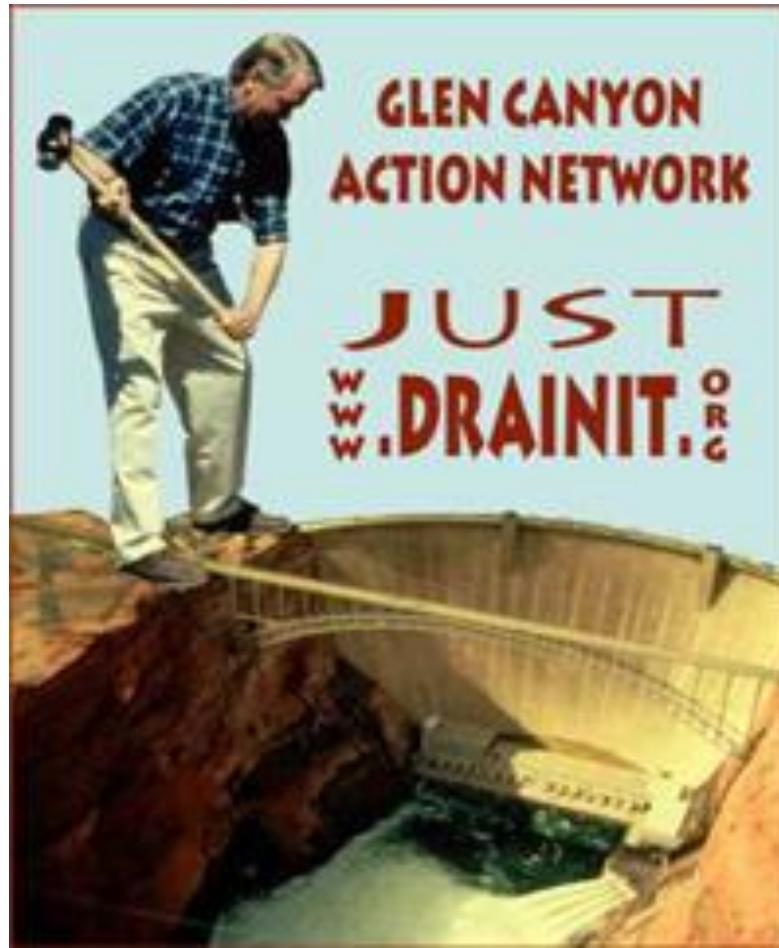
Large Initiatives/Hopes: Hetch Hetchy



RESTORE HETCH HETCHY
YOSEMITE NATIONAL PARK

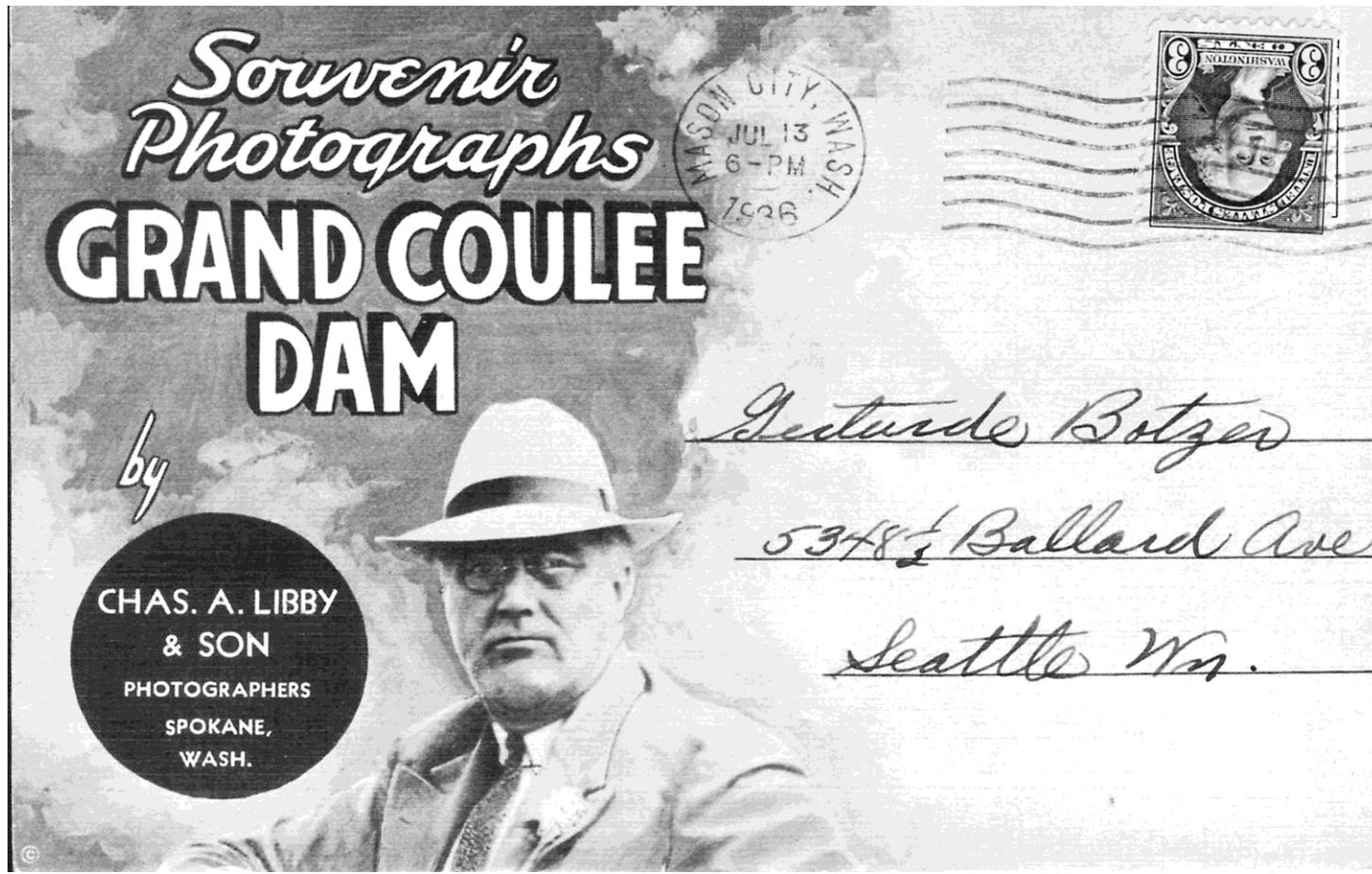
The Dam Removal Movement

Large Initiatives/Hopes: Glen Canyon



Dams and Hydroelectricity...

FDR and “New Deal” Dams: Grand Coulee



Dams and Hydroelectricity...

FDR's "New Deal" Dams: Grand Coulee 1937



Dams and Hydroelectricity...

FDR's "New Deal" Dams: Bonneville 1937



Dams and Hydroelectricity...

FDR and “Boulder Dam” 1935



The Dam Removal Movement

Glen Canyon Dam surge mitigation – 1992



Dams and Hydroelectricity...

“Go-Go” with the Army Corps: Pine Flat 1954





**Anti-Dam Reaction – Glen Canyon Dam, 1957-
64**

The Klamath and COPCO Irongate Dam (1962)



The Klamath and COPCO

J. C. Boyle Dam and Penstock (1958)



The Klamath and COPCO

Copco Dam # 2 (1925)



Dam Removal along the Klamath...

The Klamath River



The Dam Removal Movement

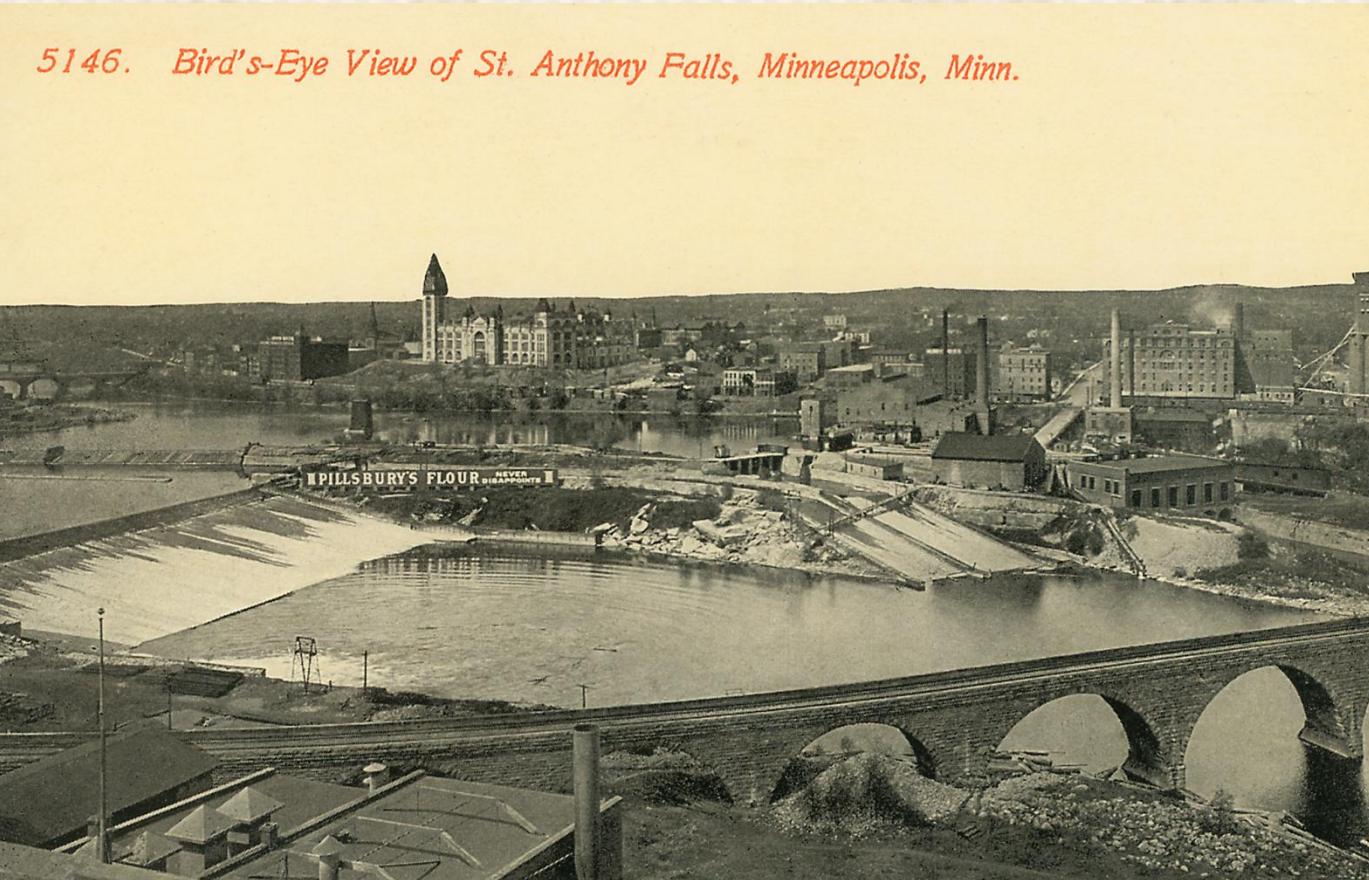
Edwards Dam Removal 1998



Dams and the Environment...

Mill Dam Heritage: Britain





Mississippi River Water Power – Minneapolis/St. Paul

The Dam Removal Movement

Sunbeam Dam, Idaho – Good Fishing...



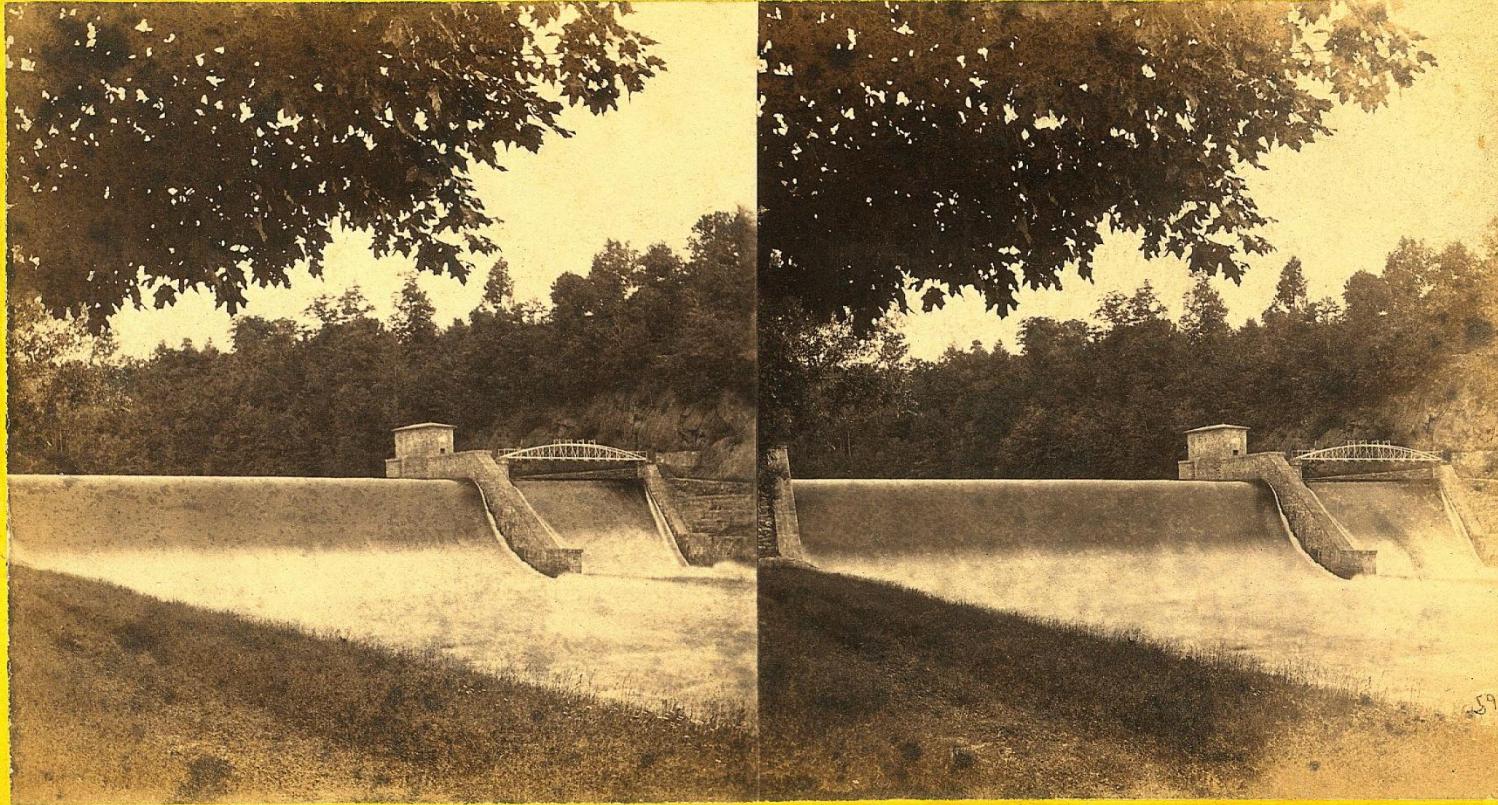
Dams and Hydroelectricity...

30 MW Big Creek No. 1 - 1913



Dams Water Energy...

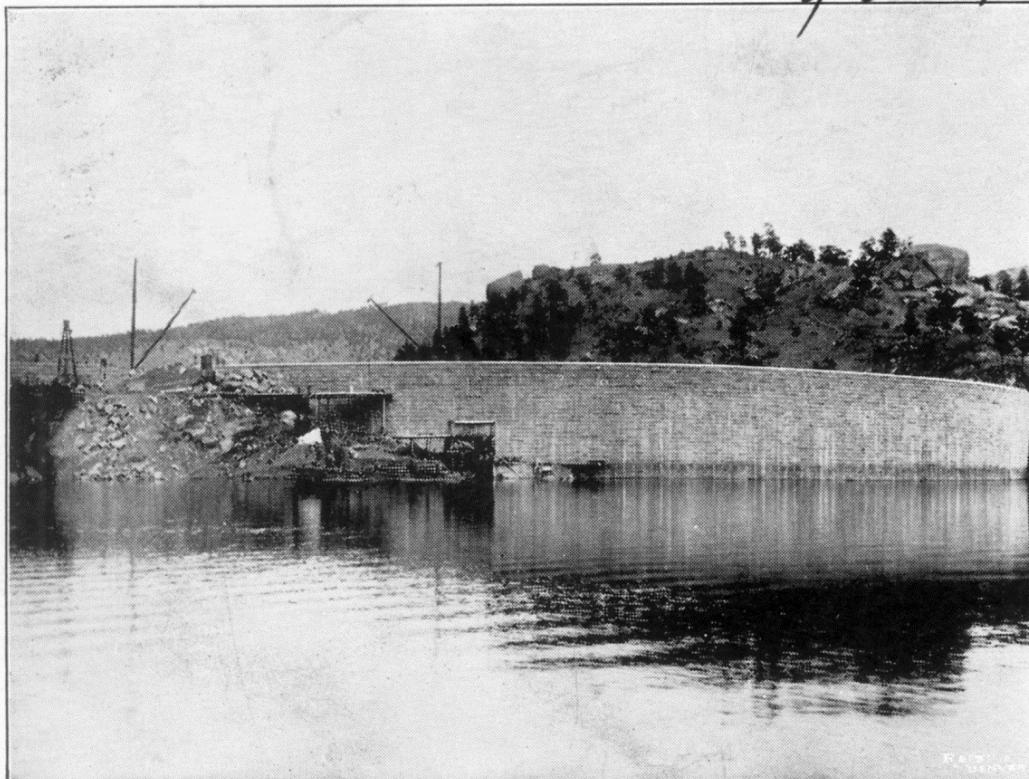
D



**Monumental Storage Dams – NYC's Croton
Dam 1842**



Monumental Dam – SF's San Mateo/Spring Valley Dam, 1886



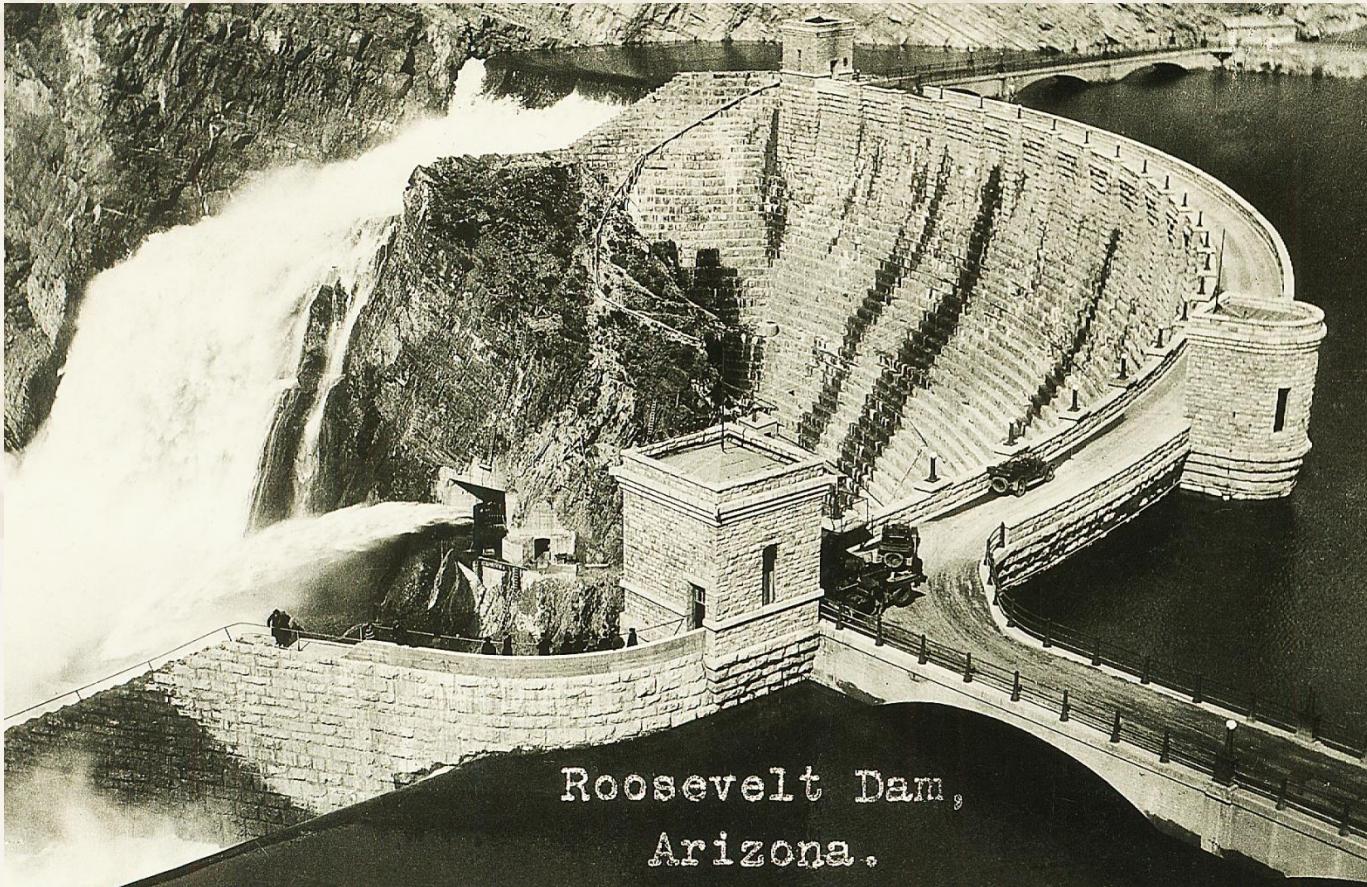
Highest in the World

Cheesman Dam.

217 Feet High

Aug 2-07. This, now completed, is where Denver gets its water supply. A friend and I are spending a week nearby - at Buffalo Park. Mabel.

Monumental Dam – Denver's Cheesman Dam,
1904



Monumental Dam – U.S. Reclamation Service, Roosevelt Dam, 1911



Monumental Dam – U.S. Reclamation Service, Elephant Butte

The Dam Removal Movement

Sunbeam Dam, Idaho – Breached 1934



Dams and the Environment...

NYC Municipal Supply: New Croton Dam 1907



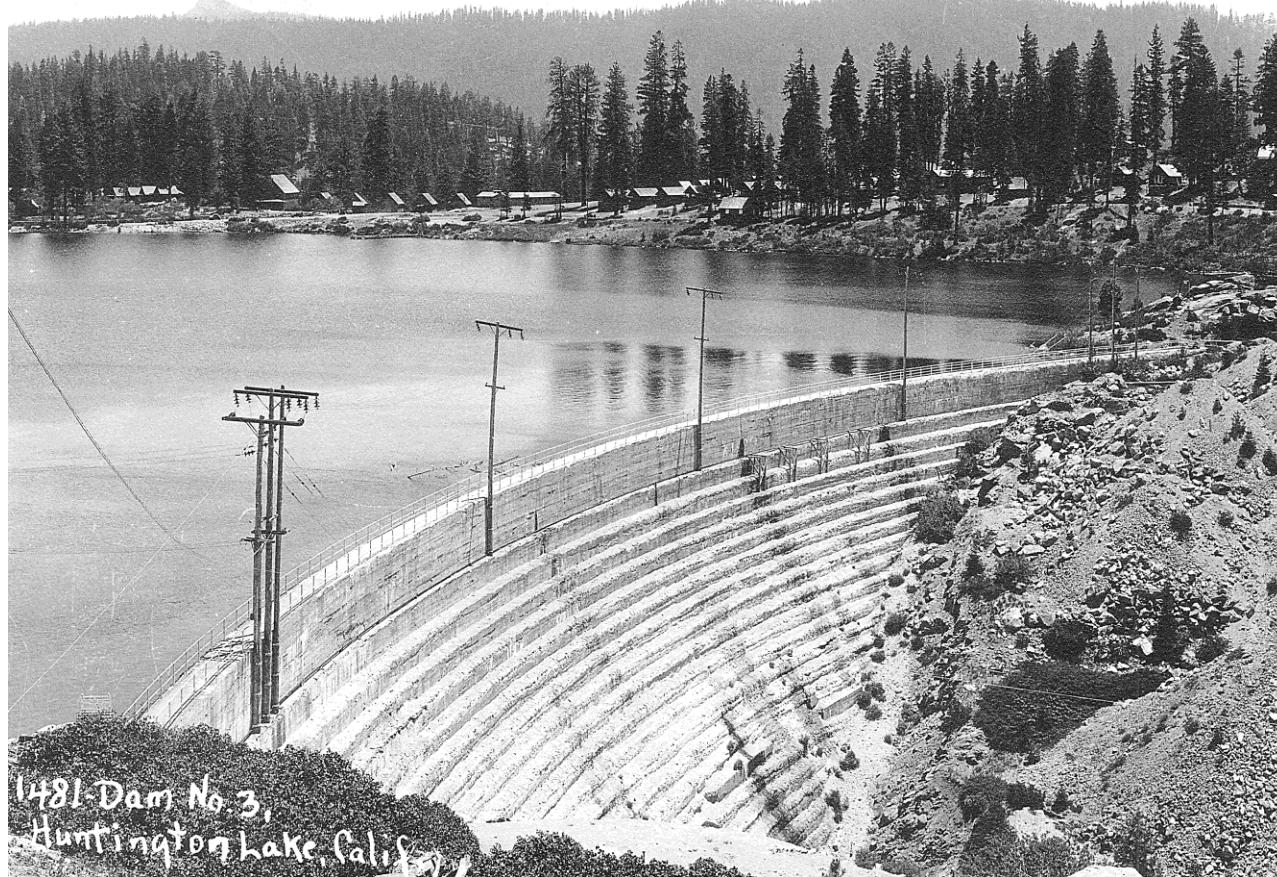
Dams and Hydroelectricity...

Hoover Dam, Colorado River (1931-35)



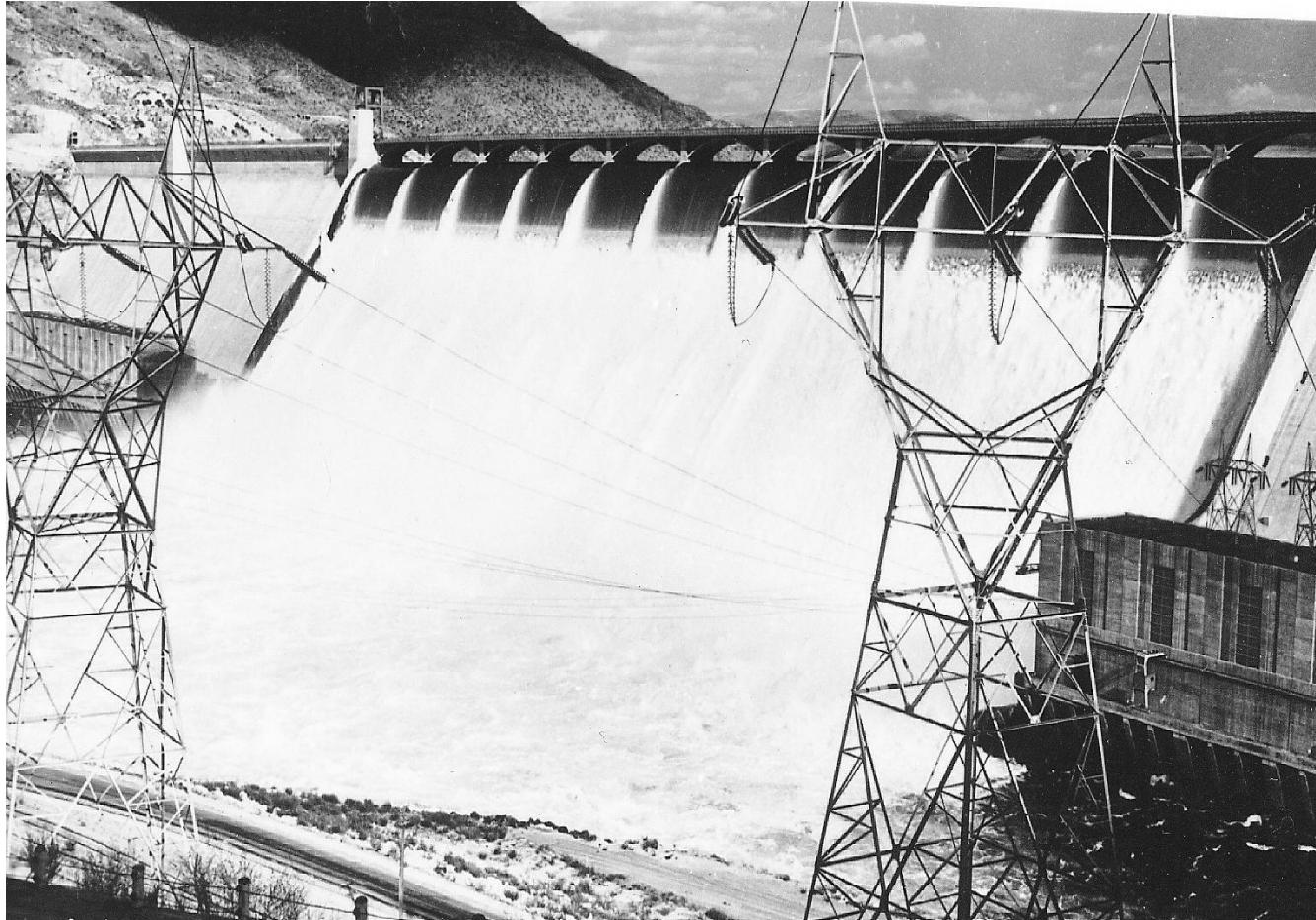
Dams and Hydroelectricity...

Sierra Nevada's Big Creek System 1913...



Dams and Fish...

No Returns...



The Dam Removal Movement

“Orphan” Dam Removals



The Dam Removal Movement

Milltown Dam: Mine Waste/Superfund Site



Dams and the Environment...

Rural Mill Dams: America



Dams Water Energy...

TVA's Fontana Dam 1944



Dams Water Energy...

Shasta Dam, Northern California 1945

