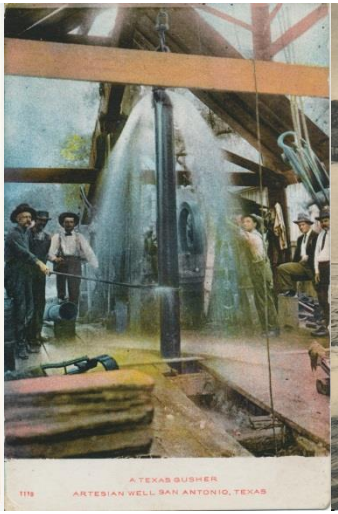
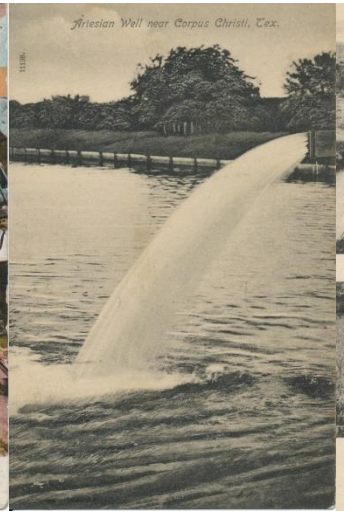
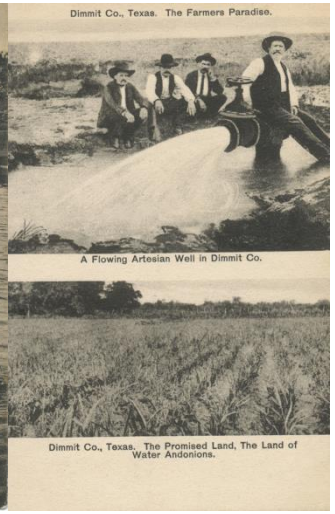
We'll know the worth of water when the wells stop flowing:

How the great artesian depletion taught Texas to conserve water





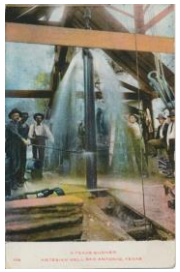
Robert E. Mace, Ph.D., P.G.

presented to

Central Texas Water Conservation Symposium

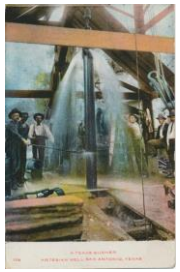
February 1, 2018; Austin, Texas





- **What is a flowing artesian well?**
- **History of artesian wells**
- **Artesian water discovered in Texas!**
- **Trouble in Flowville…**
- **Legislation (and lessons learned?)**





- **What is a flowing artesian well?**
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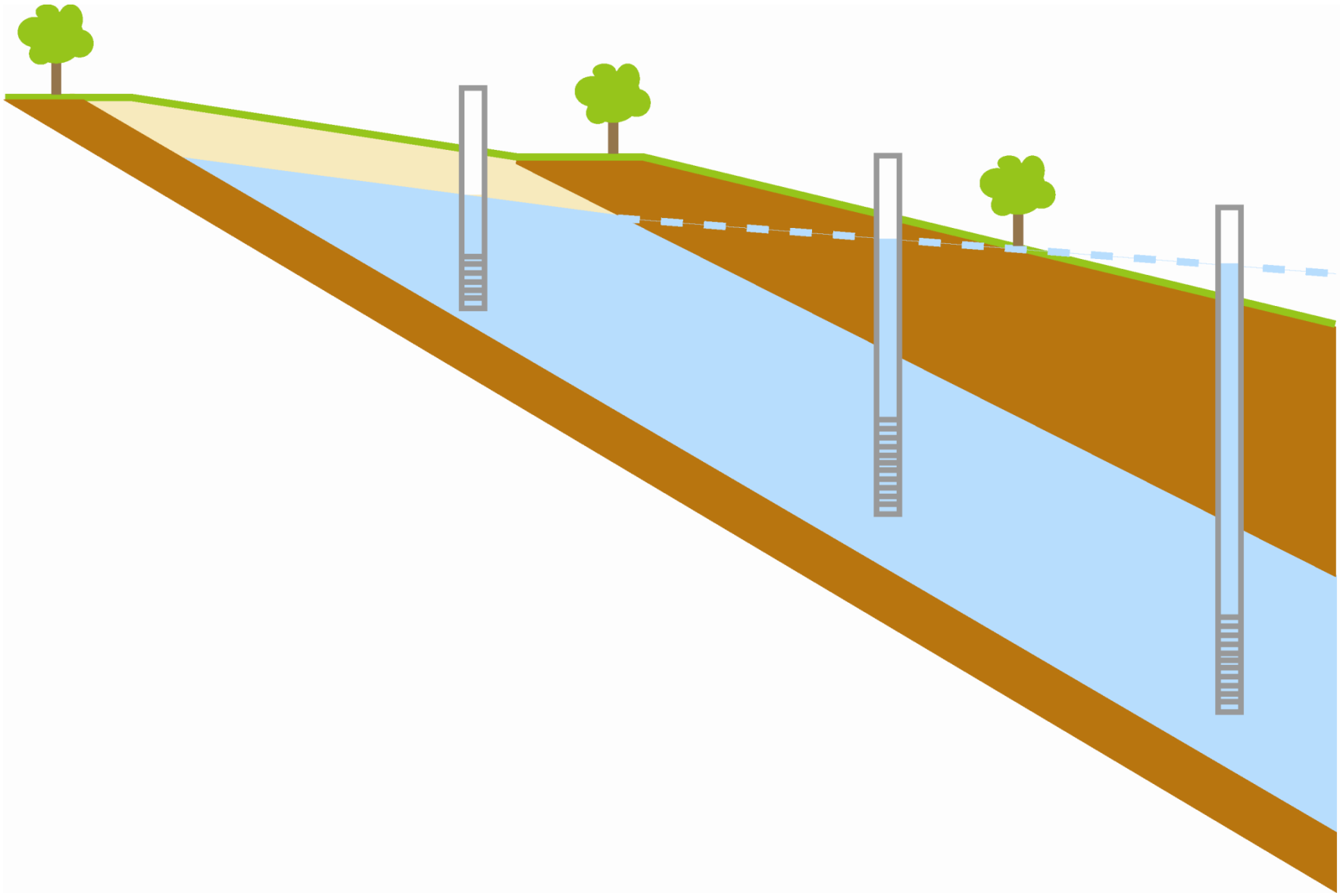
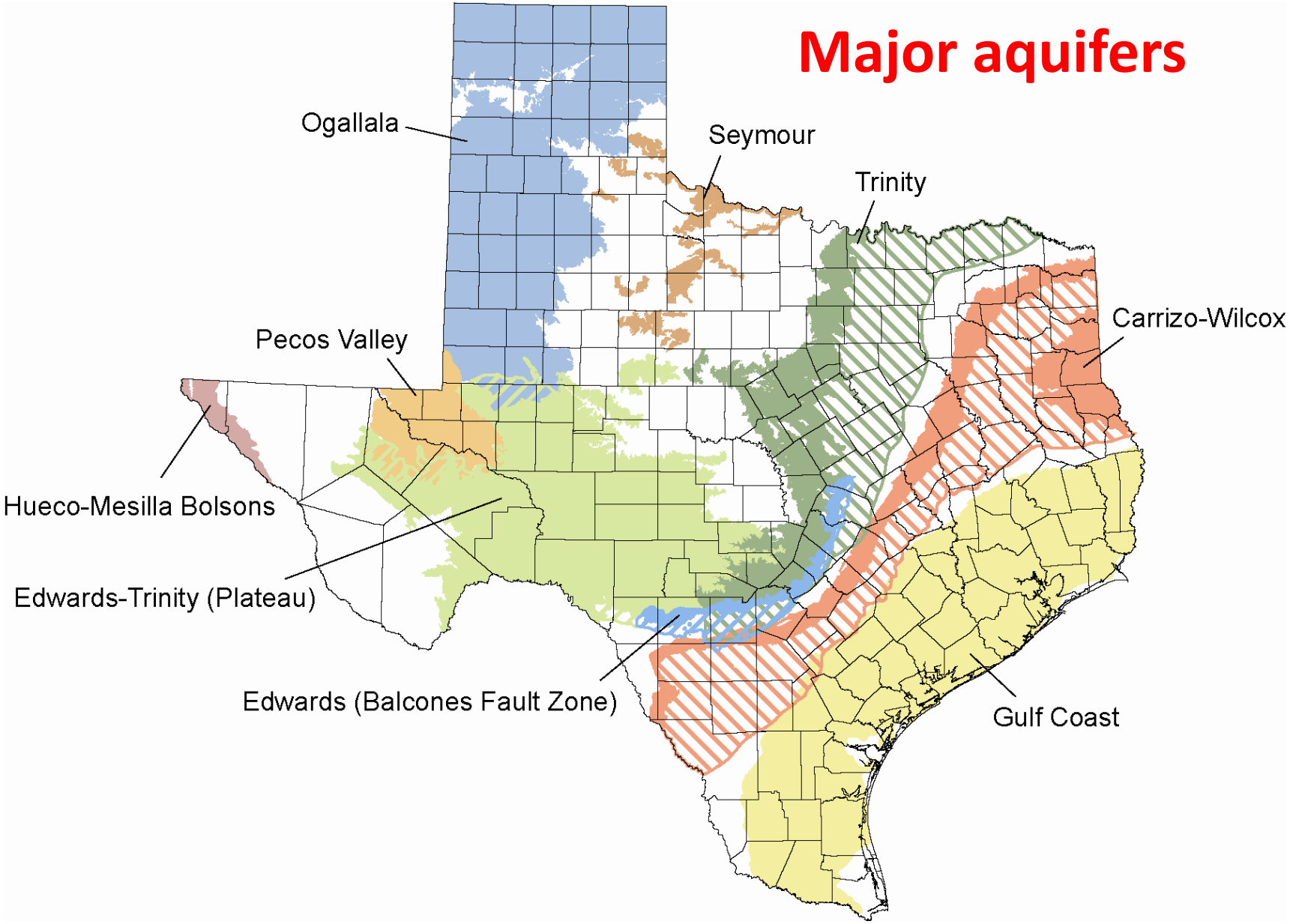
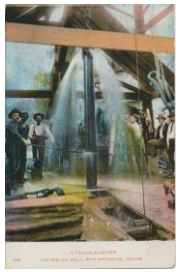
anatomy of an artesian aquifer



Major aquifers







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Egypt: 3000 BC

Egyptian bow drill:

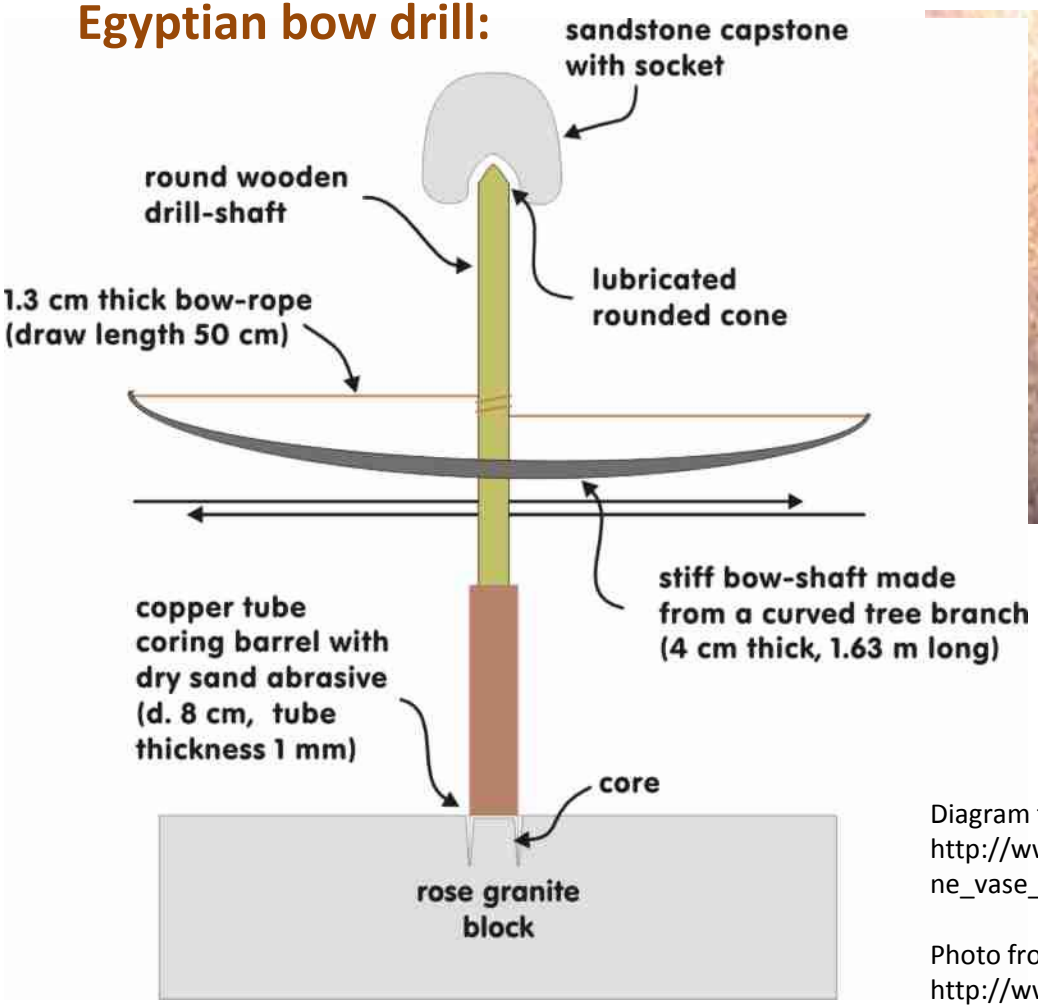
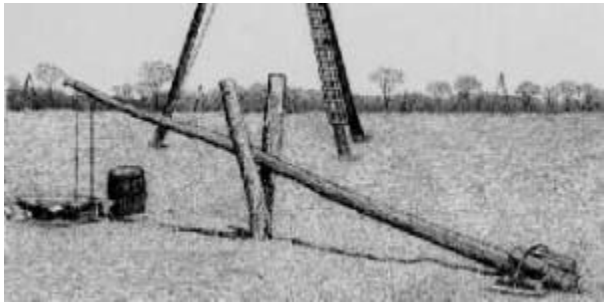
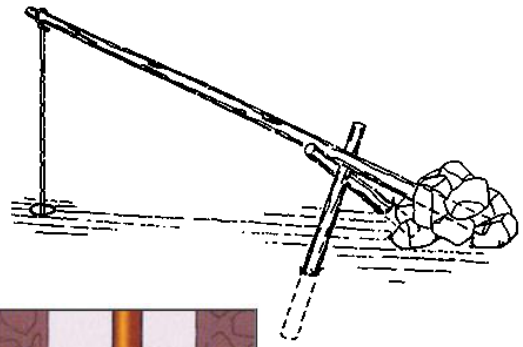
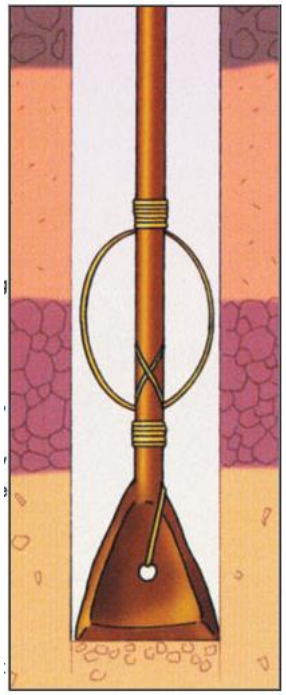


Diagram from
http://www.oocities.org/unforbidden_geology/ancient_egyptian_stone_vase_making.html

Photo from
http://www.gizapower.com/Advanced/Advanced%20Machining.html





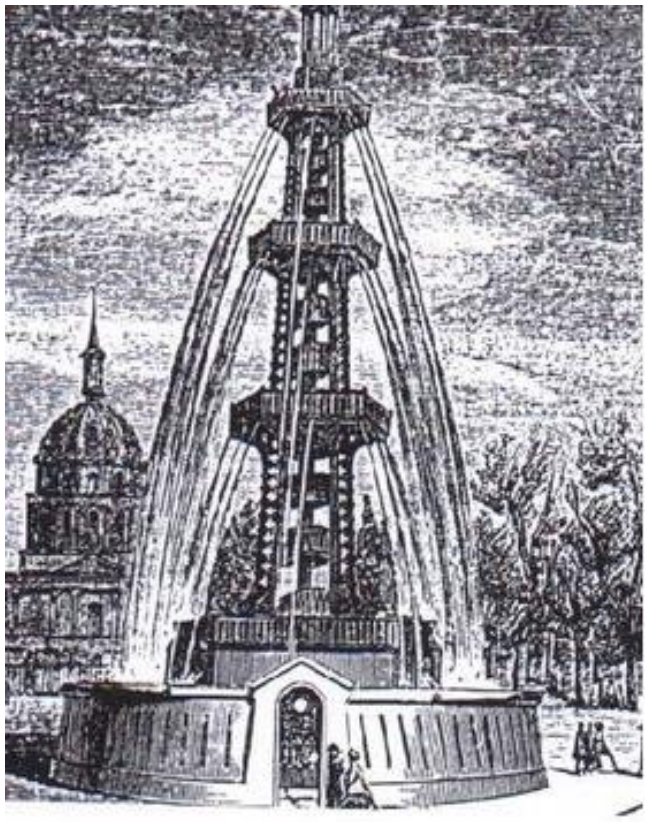


China: 300 AD

- Early cable tool
- Well casing
- Drilling mud
- 10,000 wells by 1700, some more than 4,000 feet deep

Carthusian Monks: 1126
Lillers, France
Gonnehem, France

Province of Artois



La colonne monumentale
du puits de Grenelle.

The Grenelle Well

George Mulot

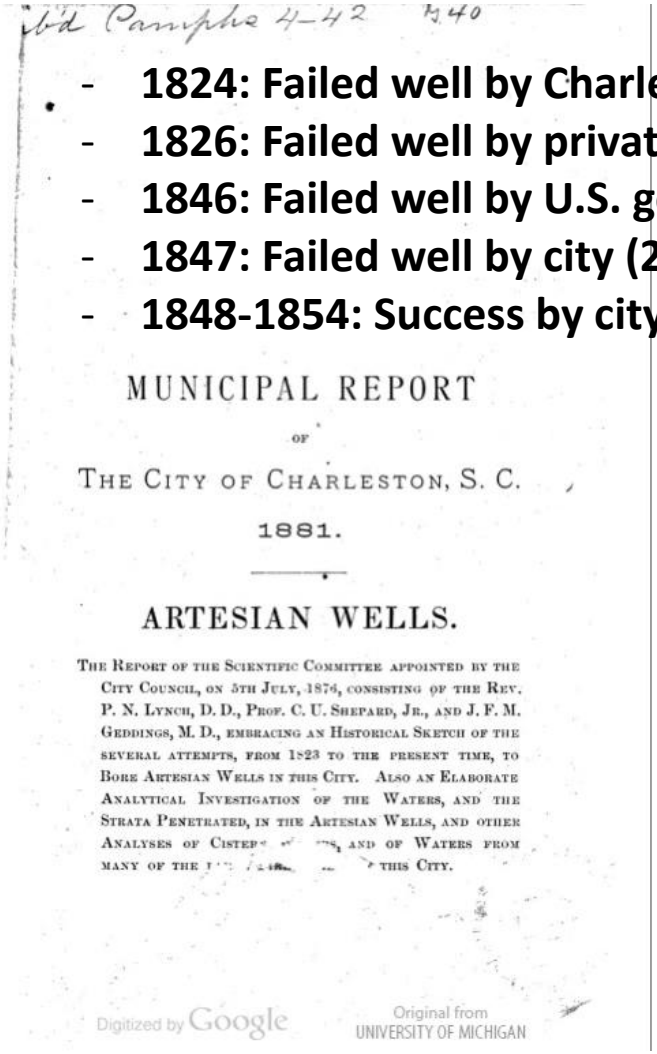
1833-1841

1,798 feet deep

800,000 gallons per day (555 gpm)

“First” deep artesian well in U.S.: Charleston, South Carolina, 1854

- **1824: Failed well by Charleston (335 feet; twisted rods)**
- **1826: Failed well by private interests (unknown depth; ran out of $)**
- **1846: Failed well by U.S. government (360 feet; twisted rods)**
- **1847: Failed well by city (280 feet)**
- **1848-1854: Success by city! Dude named A.C. Welton drilled it to 1,260 feet**



Pamphs 4-42 #40

MUNICIPAL REPORT

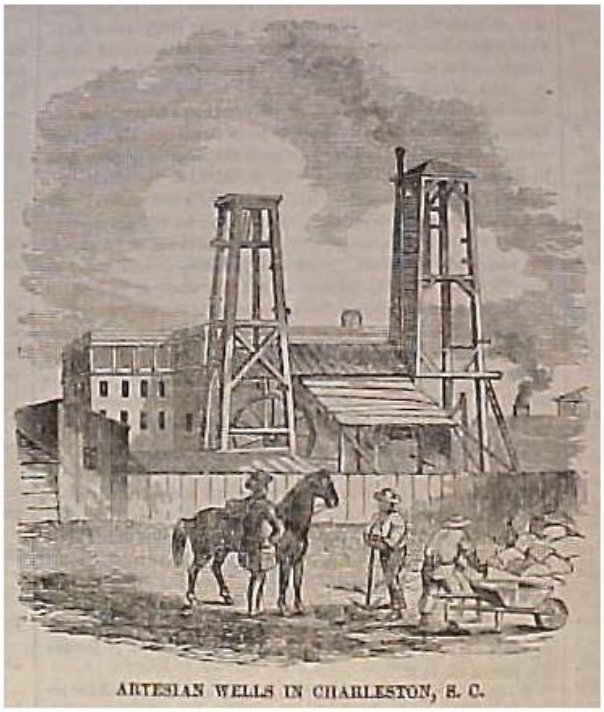
OF

THE CITY OF CHARLESTON, S. C.

1881.

ARTESIAN WELLS.

THE REPORT OF THE SCIENTIFIC COMMITTEE APPOINTED BY THE CITY COUNCIL, ON 5TH JULY, 1876, CONSISTING OF THE REV. P. N. LYNCH, D. D., PROF. C. U. SHEPARD, JR., AND J. F. M. GEDDINGS, M. D., EMBRACING AN HISTORICAL SKETCH OF THE SEVERAL ATTEMPTS, FROM 1823 TO THE PRESENT TIME, TO BORE ARTESIAN WELLS IN THIS CITY. ALSO AN ELABORATE ANALYTICAL INVESTIGATION OF THE WATERS, AND THE STRATA PENETRATED, IN THE ARTESIAN WELLS, AND OTHER ANALYSES OF CISTER[illegible] AND OF WATERS FROM MANY OF THE [illegible] THIS CITY.

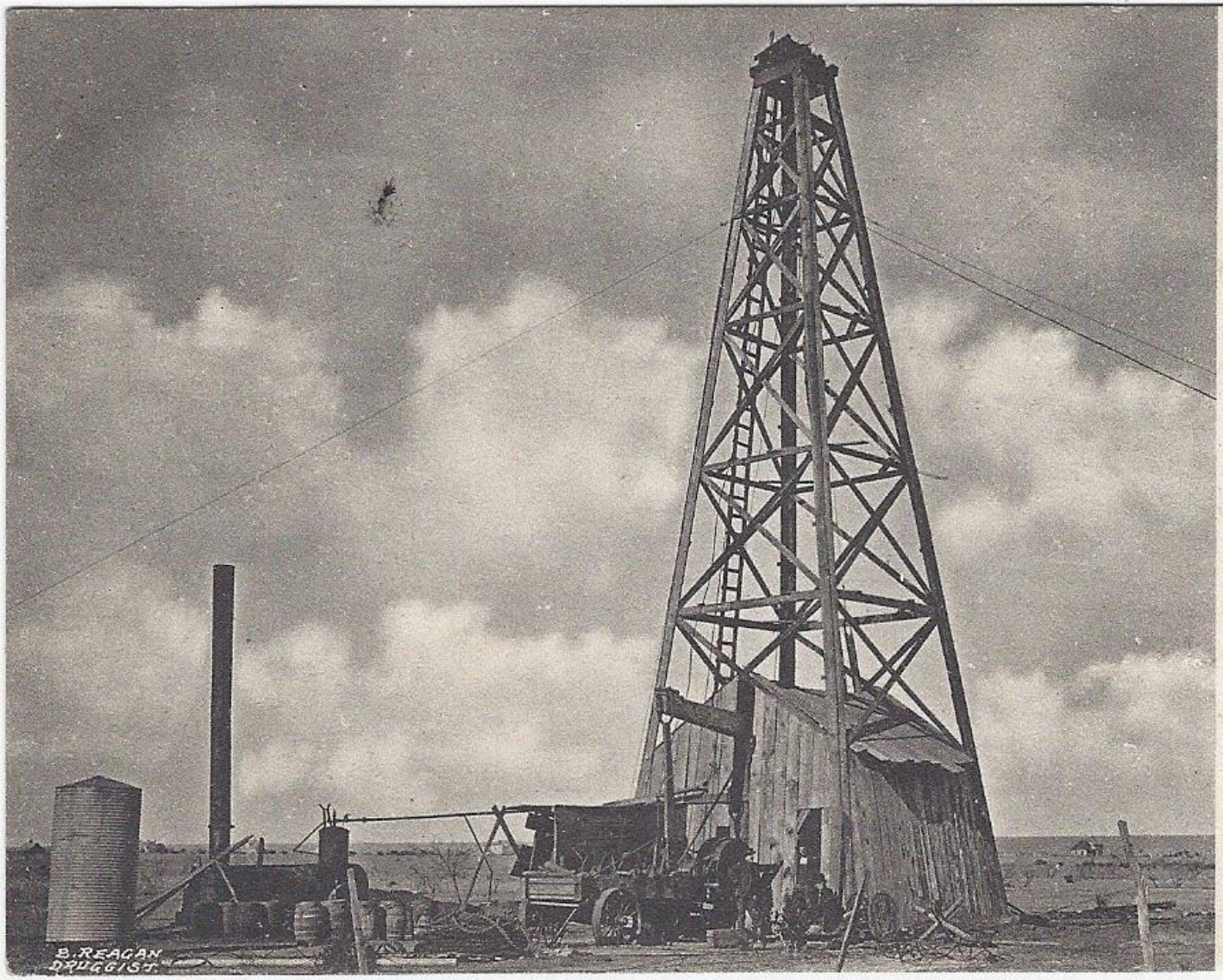


ARTESIAN WELLS IN CHARLESTON, S. C.

St Louis, Missouri: 1849-1854

2,199 feet deep

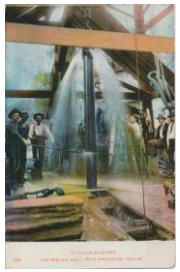
Taking the waters at Belcher's Artesian Well, St. Louis County. ***Missouri Historical Society, St. Louis***



Digging Artesian Well.

BIG SPRINGS, Texas.





- What is a flowing artesian well?
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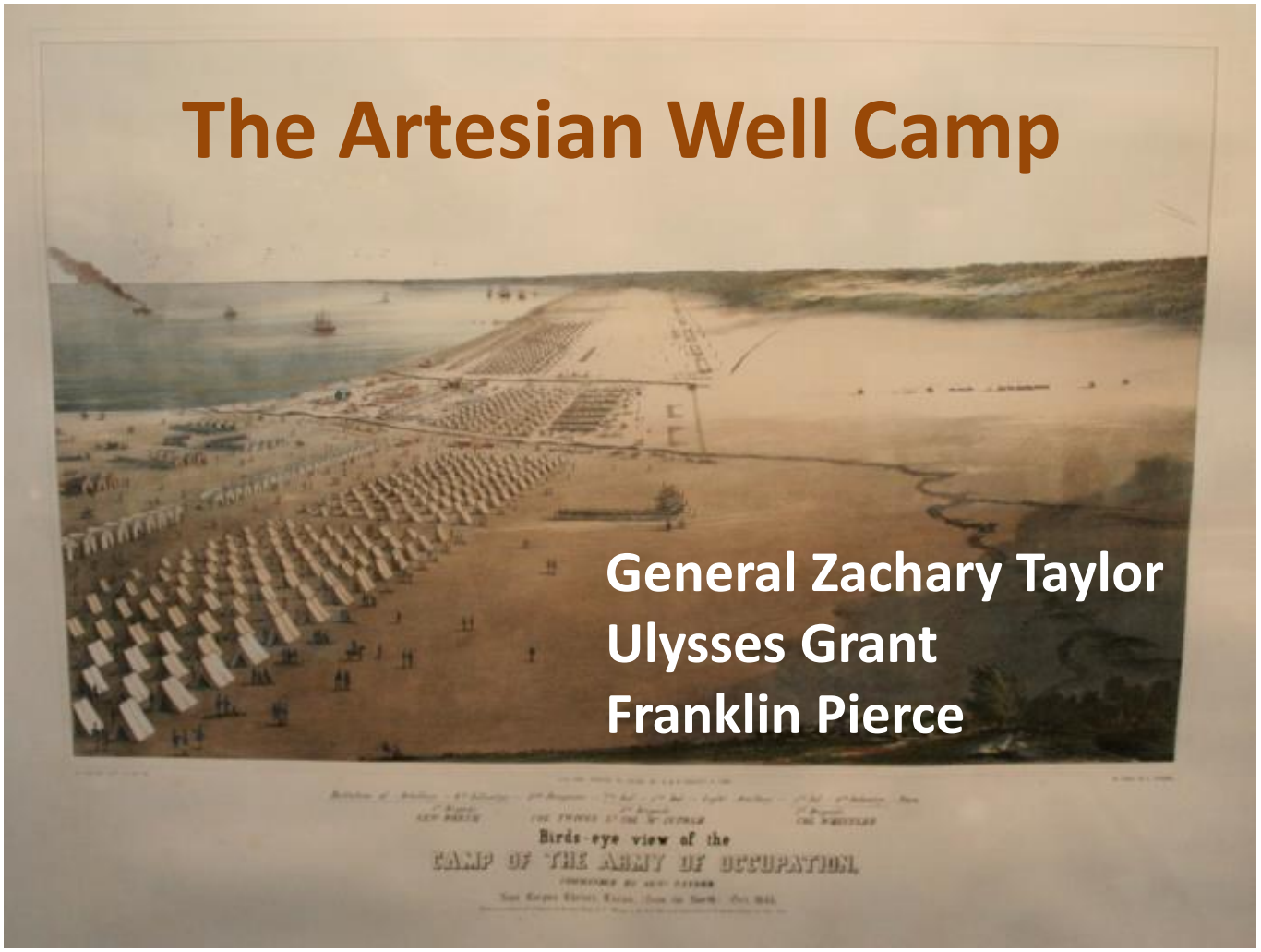
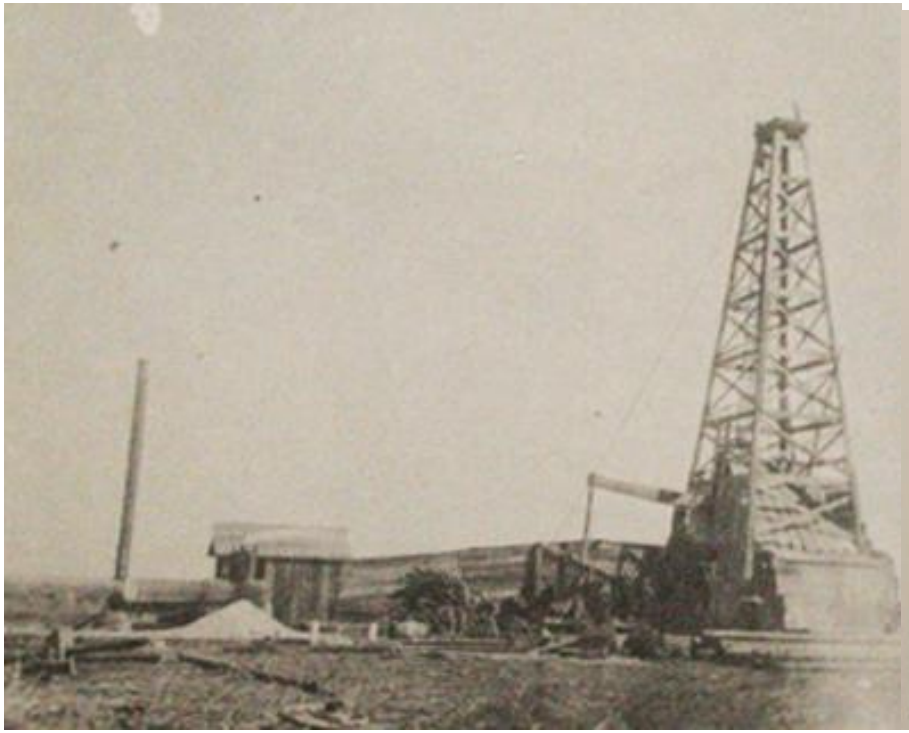
“First” artesian well in Texas: Corpus Christi, 1845




Artesian Square, Corpus Christi, Tex.

Fort Worth: 1876

Bell's Well, Waco, 1886



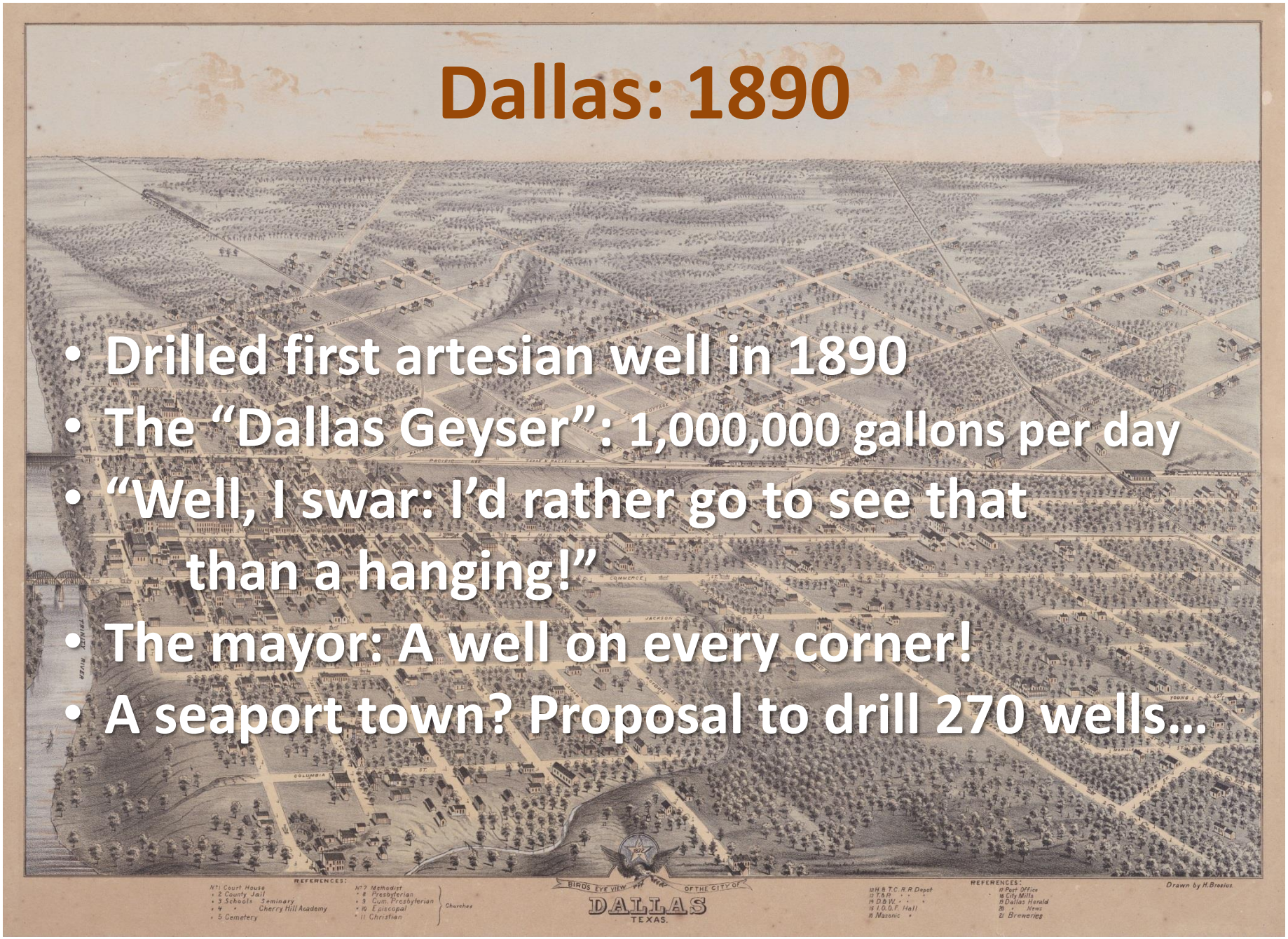
- 1,800 feet deep
- Flowed 700,000 gallons per day
- Temperature of 103 degrees F


TEXAS HISTORICAL COMMISSION
TEXAS
BELL'S HILL SCHOOL
IN MARCH 1886, JOSEPH D. BELL DRILLED WACO'S FIRST ARTESIAN WELL, AND THE AREA AROUND THE WELL BECAME KNOWN AS BELL'S HILL. THE WACO SCHOOL DISTRICT OPENED THE SIXTH DISTRICT SCHOOL AT 6TH AND FRANKLIN STREETS IN 1889; IT WAS MOVED TO A NEW STRUCTURE AT 15TH AND BURNETT BY 1904. ALL DISTRICT SCHOOLS WERE GIVEN OFFICIAL NAMES IN 1906, AND THE SIXTH DISTRICT SCHOOL BECAME THE BELL'S HILL SCHOOL. THE SCHOOL BUILDING COLLAPSED IN 1923 BECAUSE THE SOIL BENEATH IT WAS UNSTABLE. A NEW STRUCTURE WAS ERECTED AT THE FORMER LOCATION OF THE BELL WATER COMPANY'S WELL IN 1925. THE FACILITY WAS EXPANDED IN 1954, WITH FURTHER EXPANSIONS AND ADDITIONS MADE IN 1988. IN 1998 THE SCHOOL SERVED APPROXIMATELY 600 STUDENTS.
(1998)

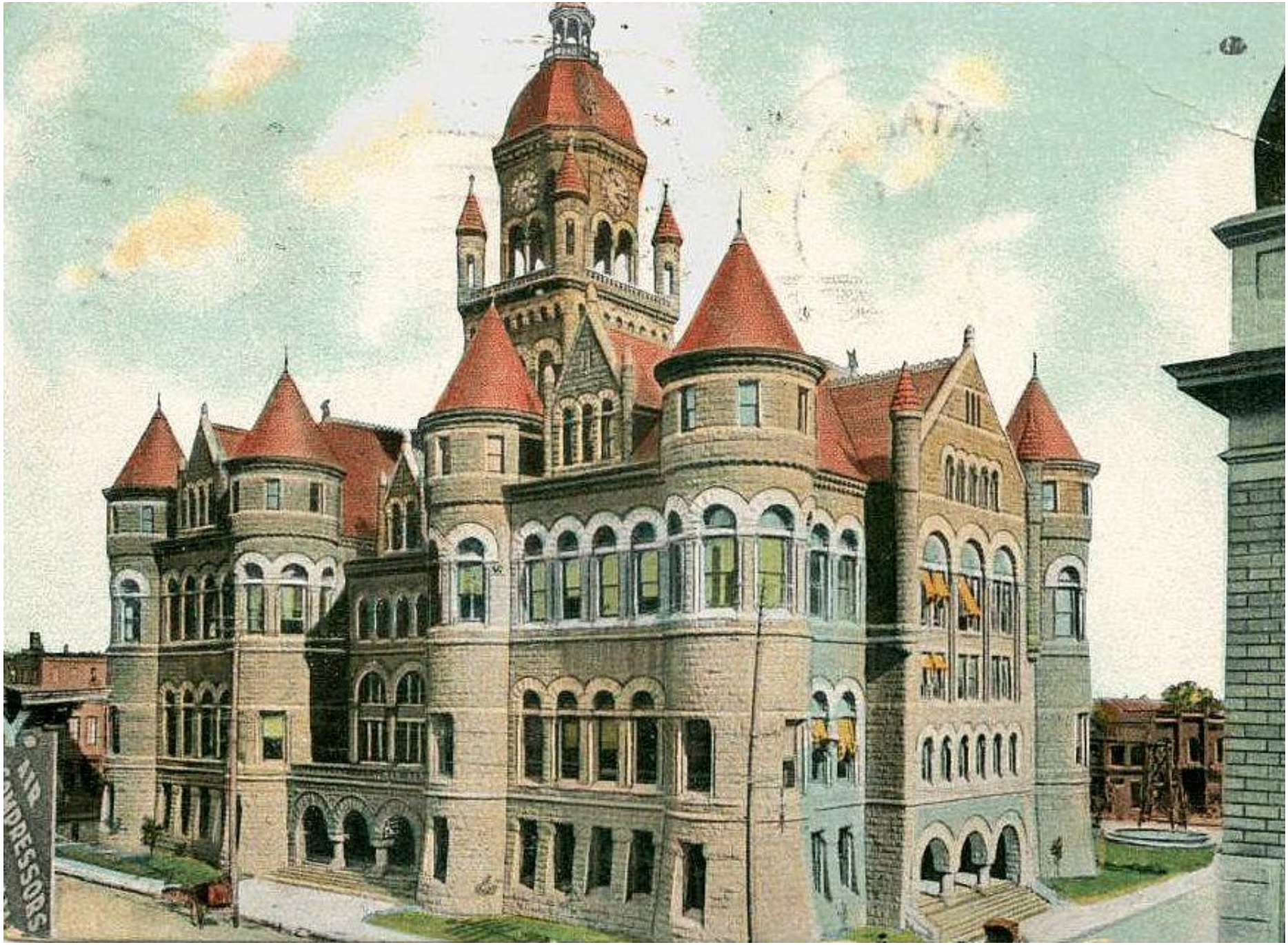

Artesian MFG & Bottling Co

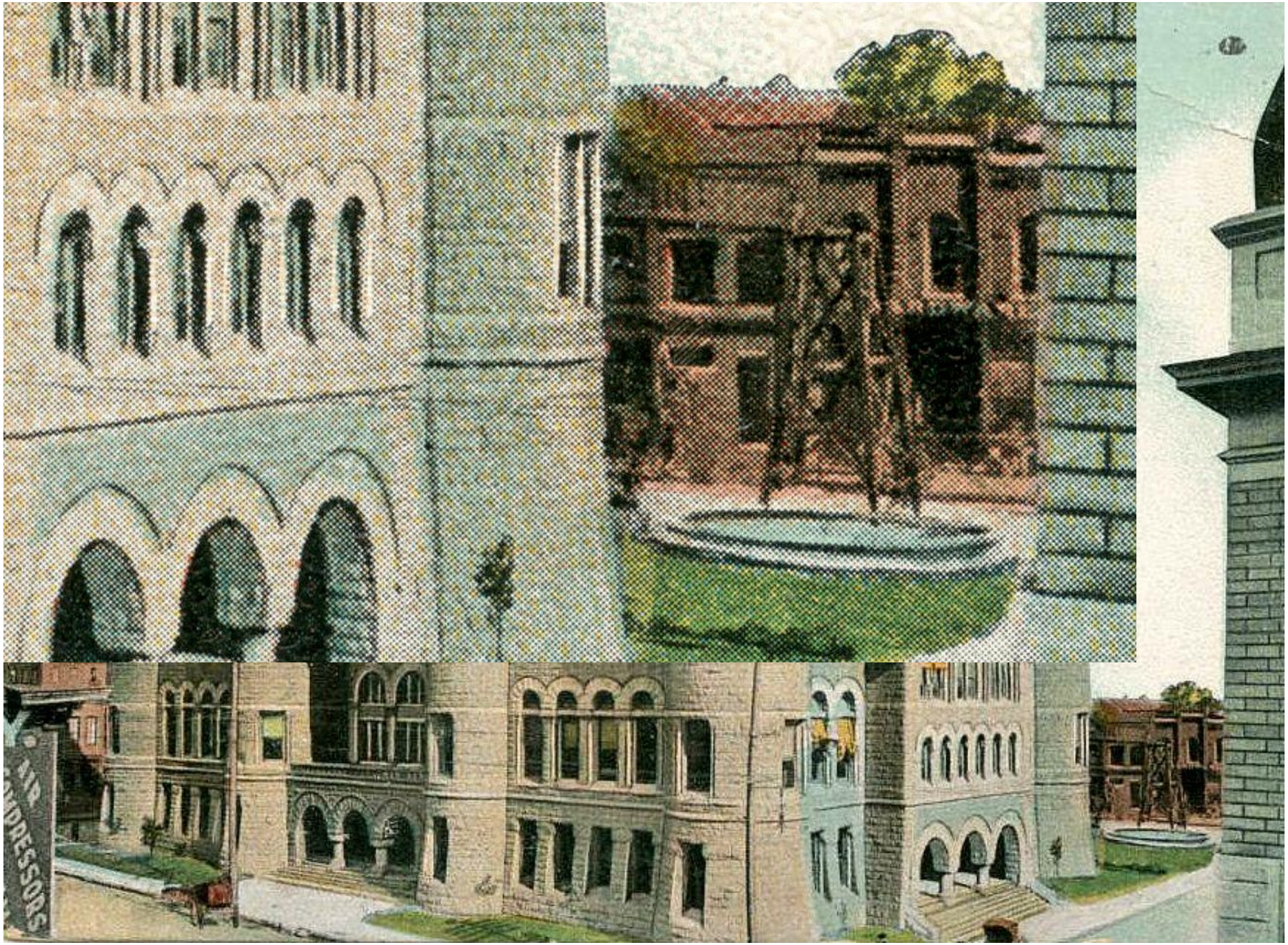
Dr Pepper

Dallas: 1890



- Drilled first artesian well in 1890
- The "Dallas Geyser": 1,000,000 gallons per day
- "Well, I swar: I'd rather go to see that than a hanging!"
- The mayor: A well on every corner!
- A seaport town? Proposal to drill 270 wells…


AIR
COMPRESSORS


AIR
COMPRESSORS

A TEXAS GUSHER

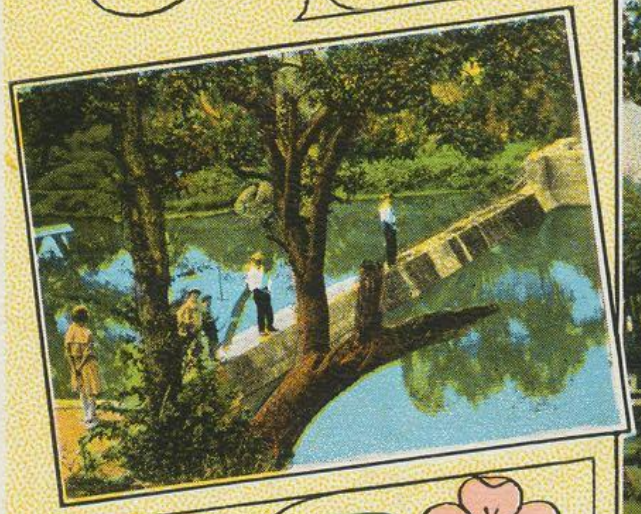
1110 ARTESIAN WELL SAN ANTONIO, TEXAS

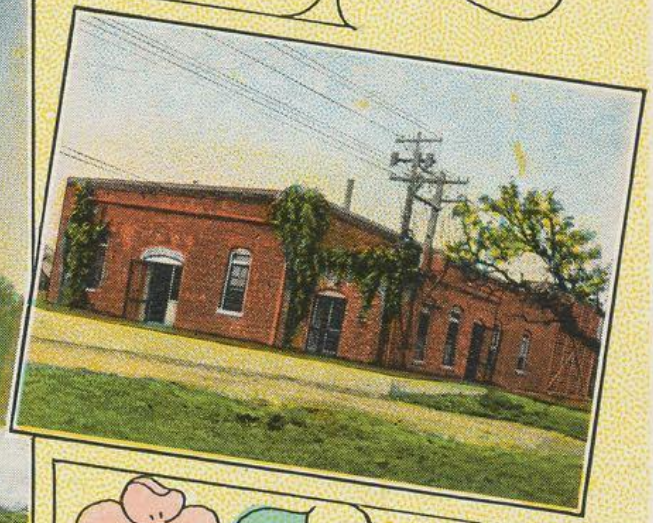

Flowing Artesian Well,
Houston, Texas
211.882 J.V.


PECOS VALLEY
PUBLG. CO.
PRODUCTS OF THE PECOS VALLEY.

PORT ARTHUR ARTESIAN WELL NO. I, PORT ARTHUR, TEXAS

PHOTO BY ST. CLAIR.





BATHING POOL, WATER WELL AND POWER PLANT—ALL MUNICIPALLY OWNED AT BRADY, TEXAS. 105105

Te.ting Rice Well, El Campo, Texas

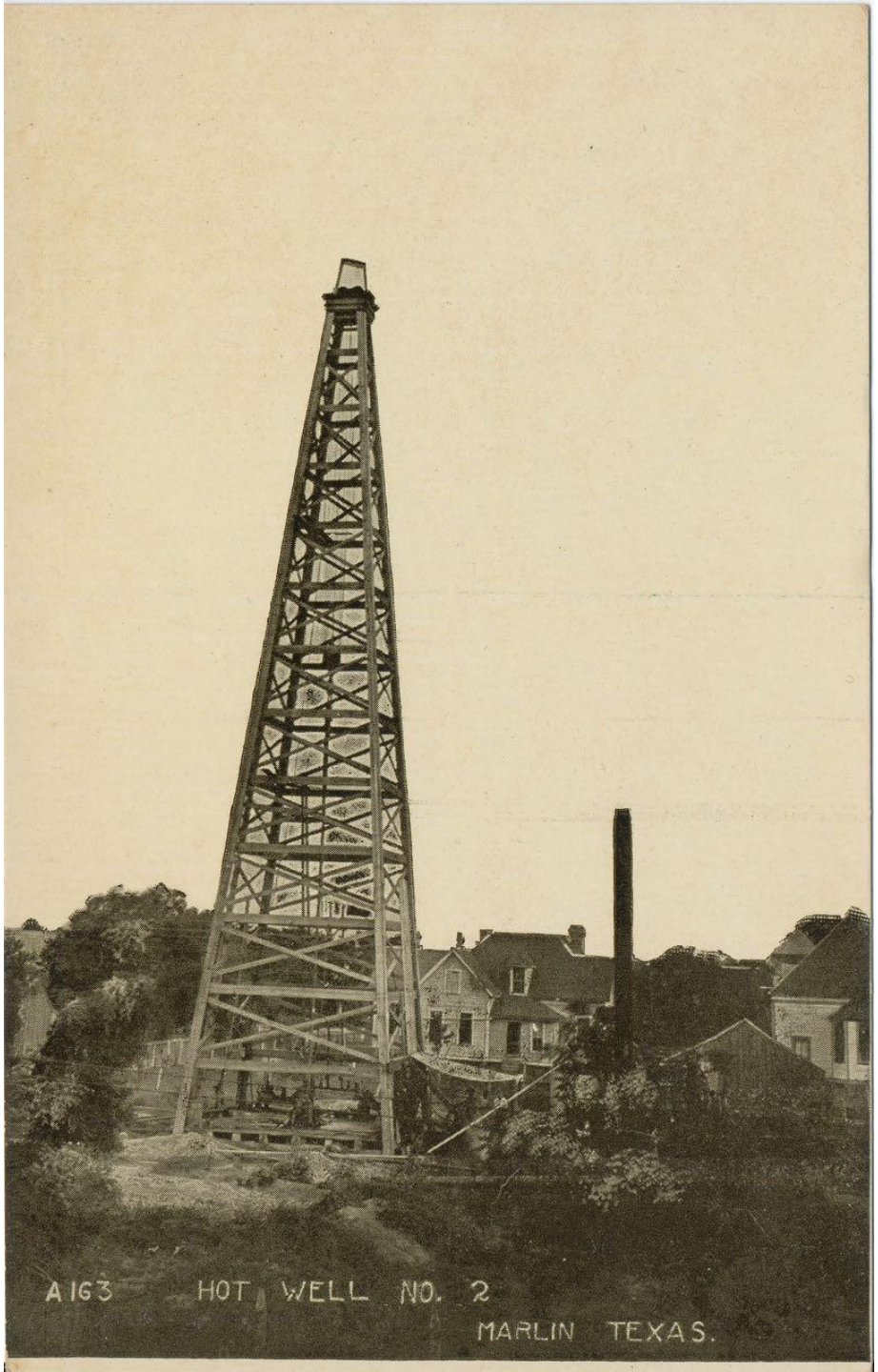
Pub''s'ed by Our Drug Store


Artesian
well,
Lytton, Tex.

U.S. FISH HATCHERY, WITH SOUTH-WEST TEXAS NORMAL IN BACKGROUND.

SAN MARCOS,
TEXAS.

Hallo- Alf.
Just thought of you for the first time Because since I saw you last (?)
Albert


A163 HOT WELL NO. 2
MARLIN TEXAS.

TORBETT CLINIC AND HOSPITAL, HOT WELL PAVILION, MAJESTIC HOTEL AND BATH HOUSE — MARLIN, TEXAS

2A-H258


CHAMBER OF COMMERCE
VISITOR

HOT WELL NO. 1. FLOWING WATER, FREE. MARLIN, TEXAS.

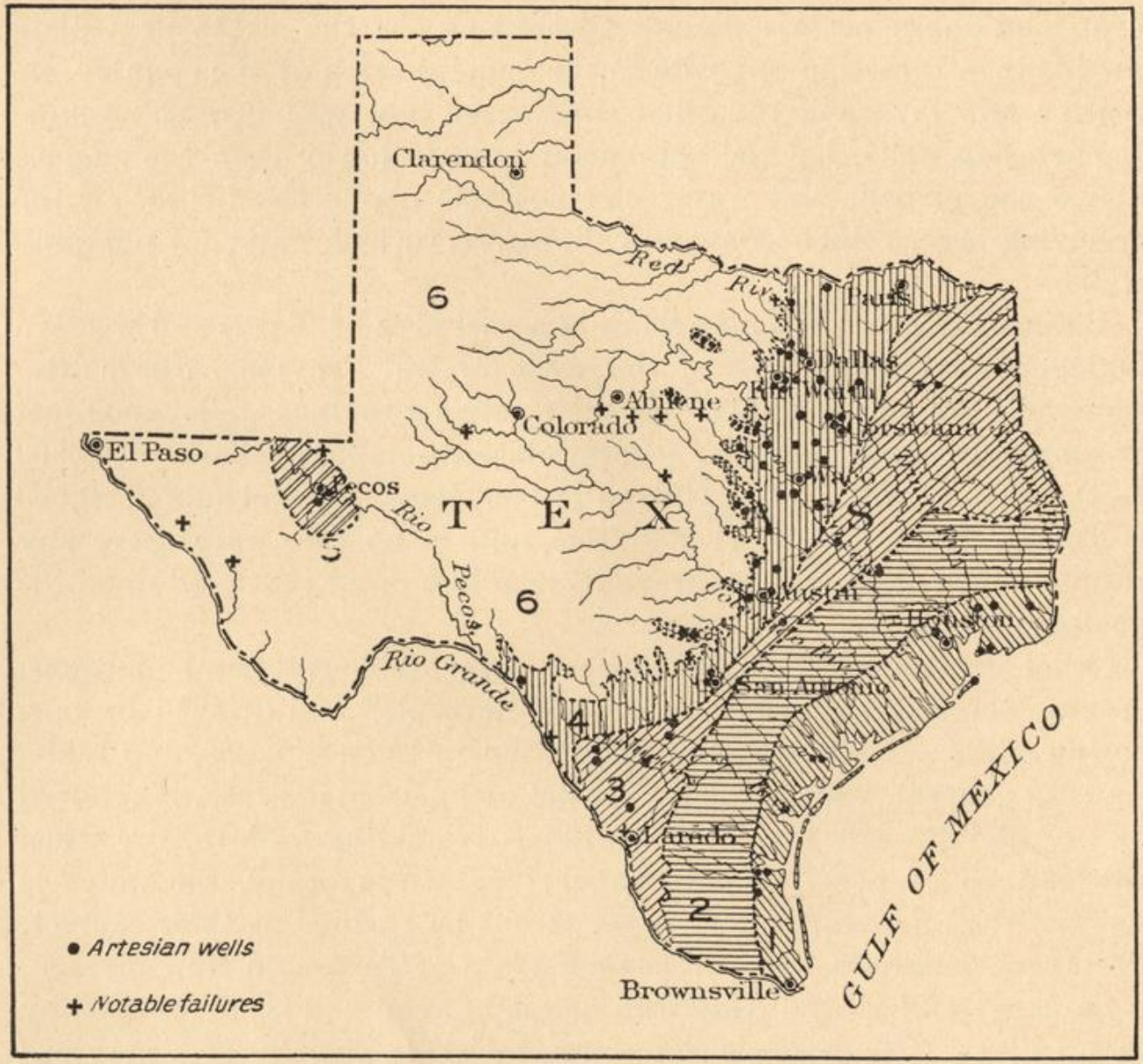
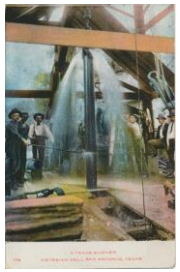


FIG. 44.—Map showing artesian districts of Texas.

1, Coast Prairie system; 2, Hallettsville system; 3, Carrizo system; 4, Black and Grand prairies system; 5, Trans-Pecos Basin system; 6, Stevens County and Jack County systems.





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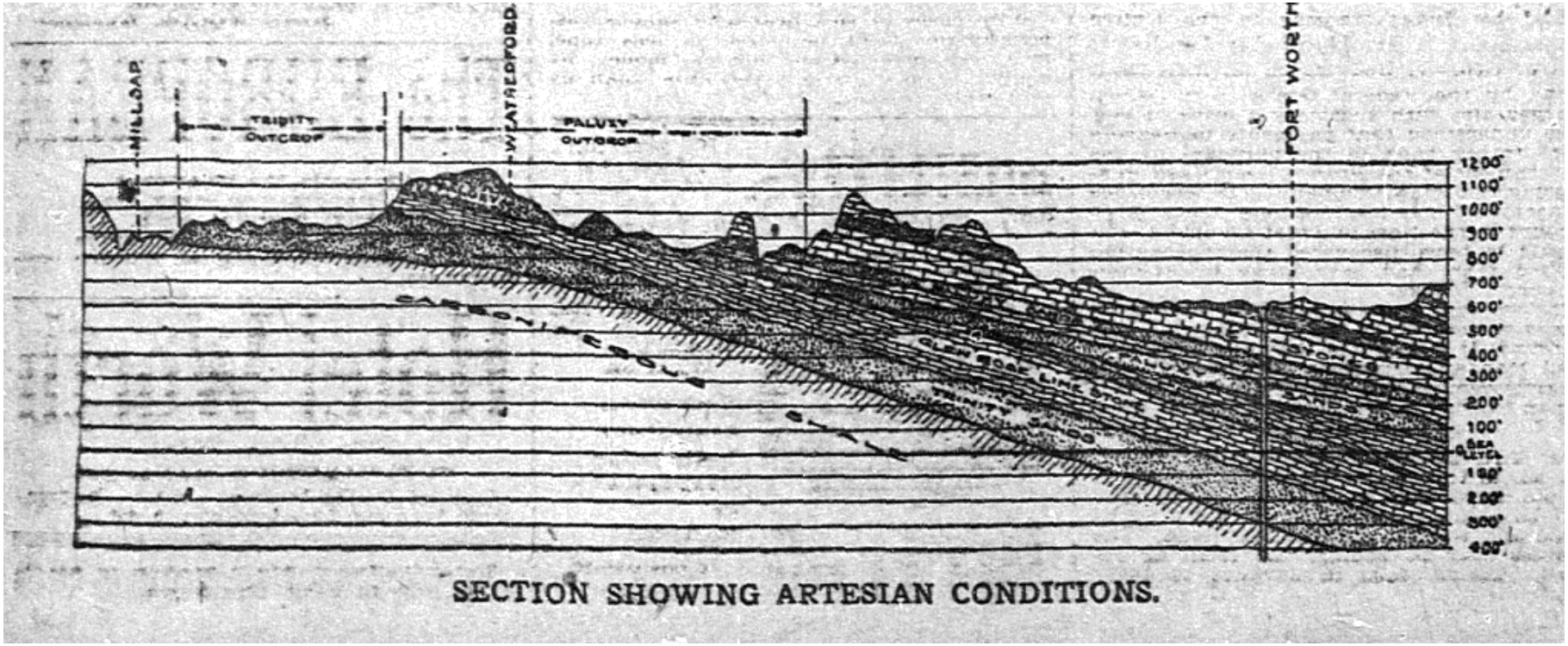
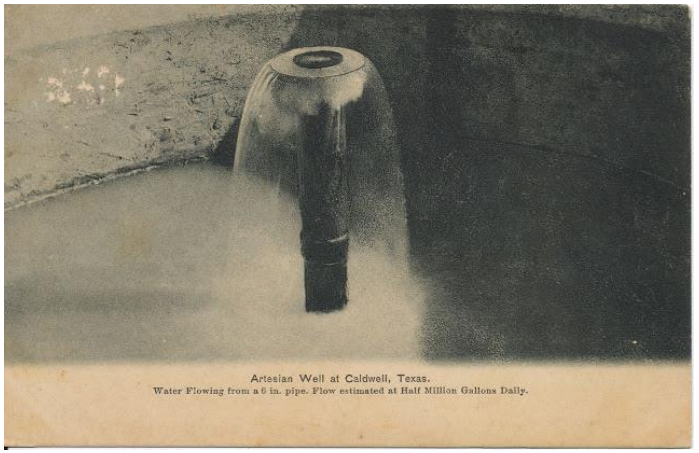
Where's the water coming from?



SECTION SHOWING ARTESIAN CONDITIONS.

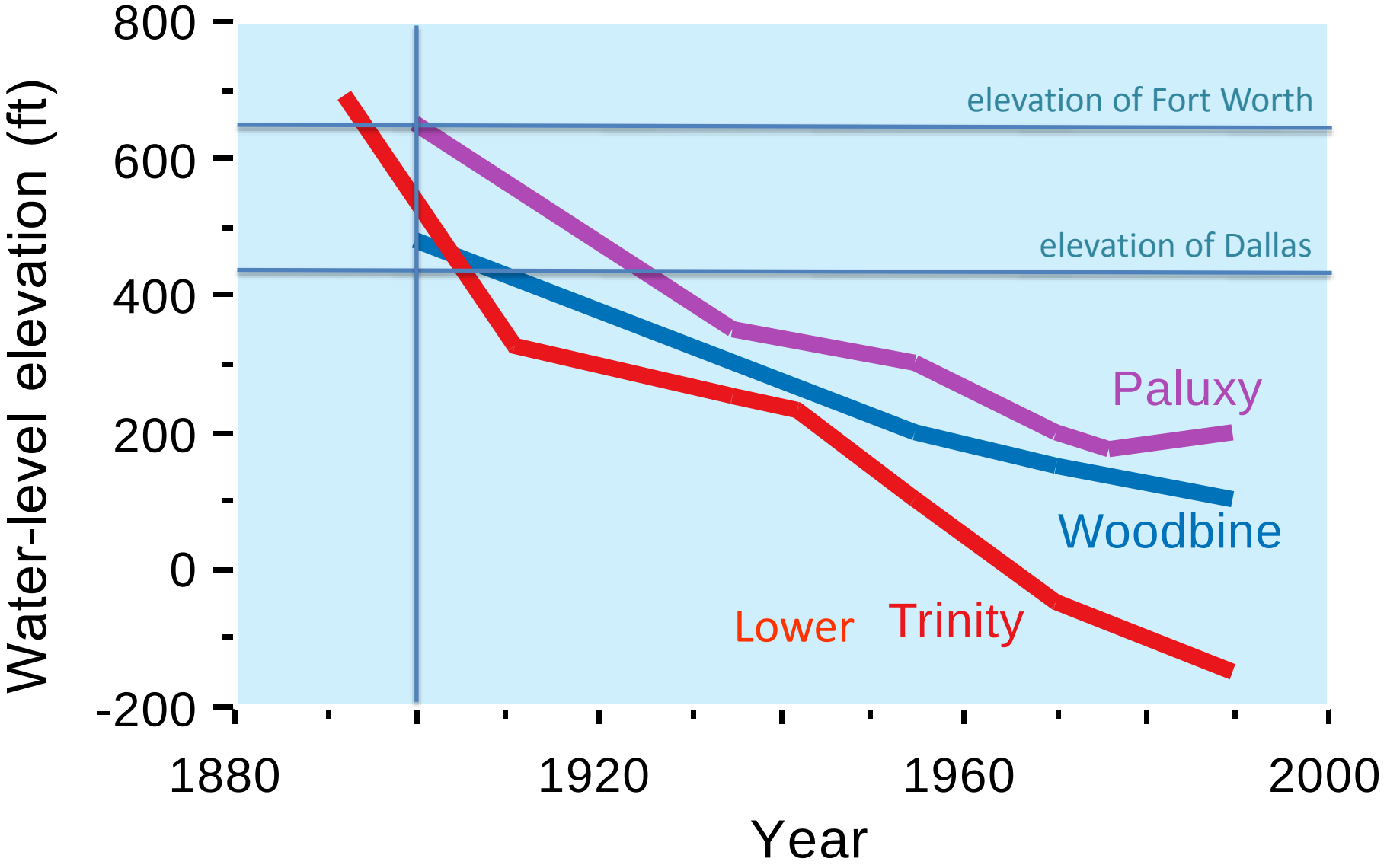
- **Dallas Morning News: The Great Lakes**
- **Judge Bower**
  - **Ozarks**
- **C.D. Wilbur, Nebraska Academy of Sciences**
  - **White sand connected to the Rocky Mountains**
  - **Arctic Ocean**
- **Robert T. Hill had the right answer! (but…)**

Flow down!!!

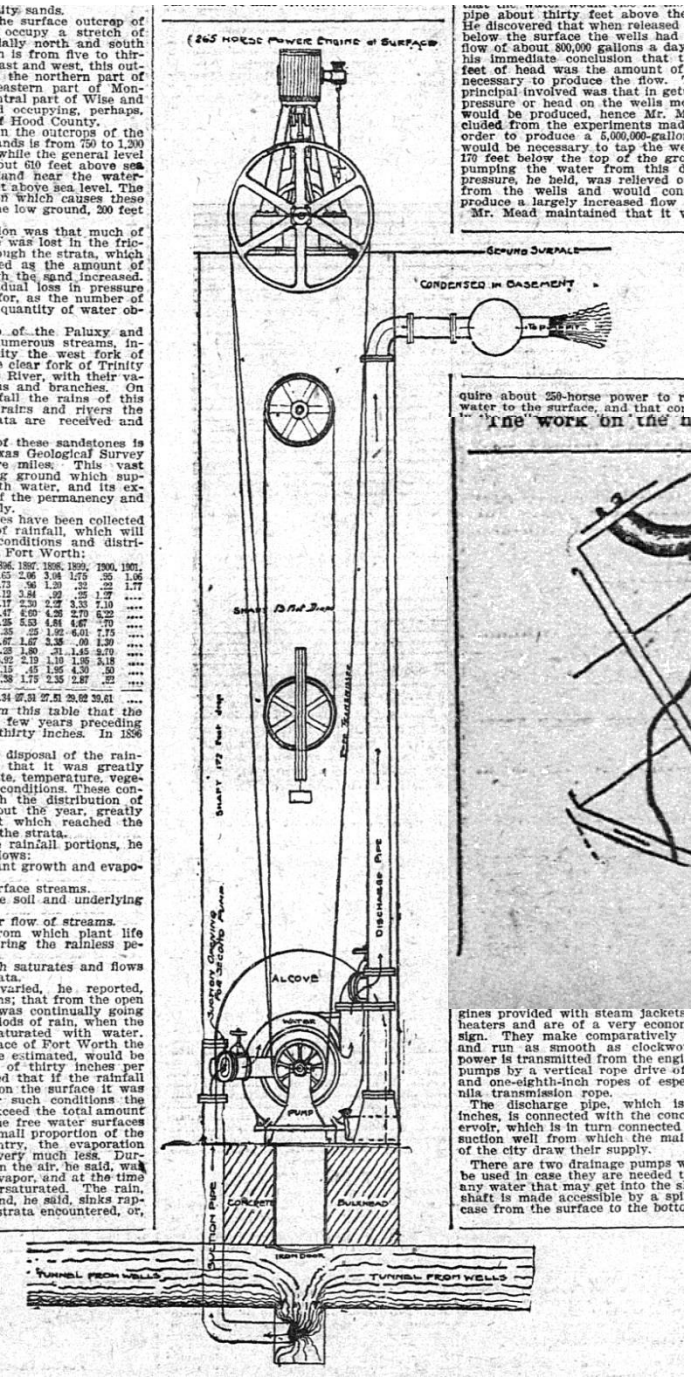


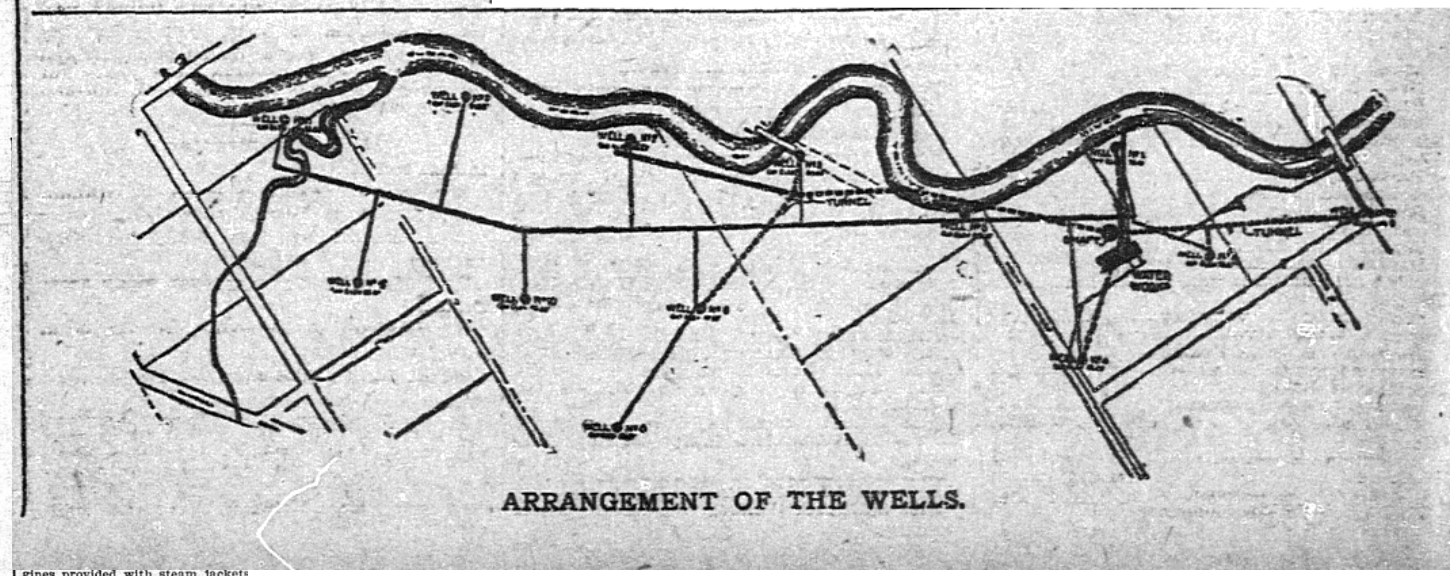
- 1891 in Dallas: Decreased flow with multiple wells
- 1894 in Fort Worth: 237 out of 240 stopped flowing
- Woodbine wells stopped flowing in Dallas by 1905
- Digging pump pits
- Started using air pumps

Water-level declines



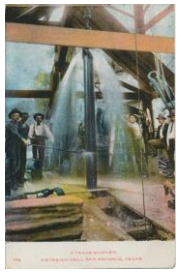
- **13-feet in diameter, 172 feet deep shaft**
- **Over a mile in tunnels**
- **13 wells**
- **Abandoned by 1910**





1903, Dallas Morning News





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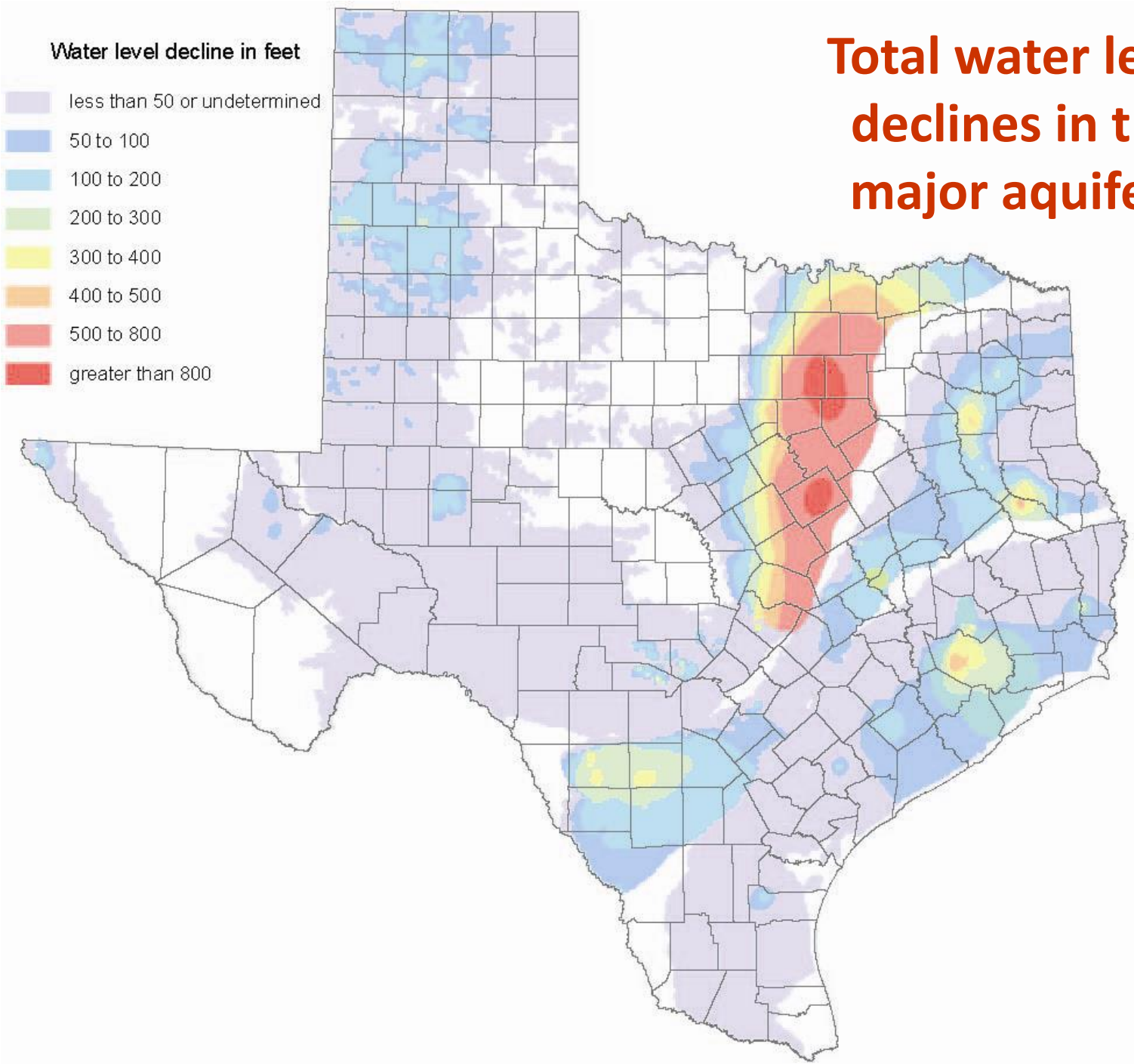
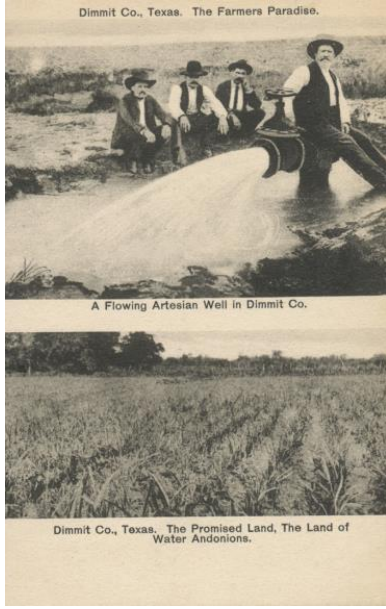
Burges-Glasscock Act

1913

Total water level declines in the major aquifers



Lessons learned?



- **Science is not always right.**
  (but tends to be righter than others…)
  - Understand and communicate uncertainty
- **People believe what they want to believe.**
  - Especially if it doesn't require them to change behavior
- **Reality (truth!) wins in the end.**
- **"Americans can always be trusted to do the right thing, once all other possibilities have been exhausted." –Winston Churchill**

Robert E. Mace, Ph.D., P.G.
robertemace@txstate.edu