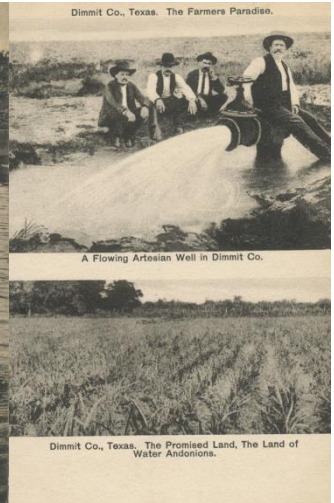


# We'll know the worth of water when the wells stop flowing: How the great artesian depletion taught Texas to conserve water



**Robert E. Mace**, Ph.D., P.G.  
*presented to*

Central Texas Water Conservation Symposium  
February 1, 2018; Austin, Texas

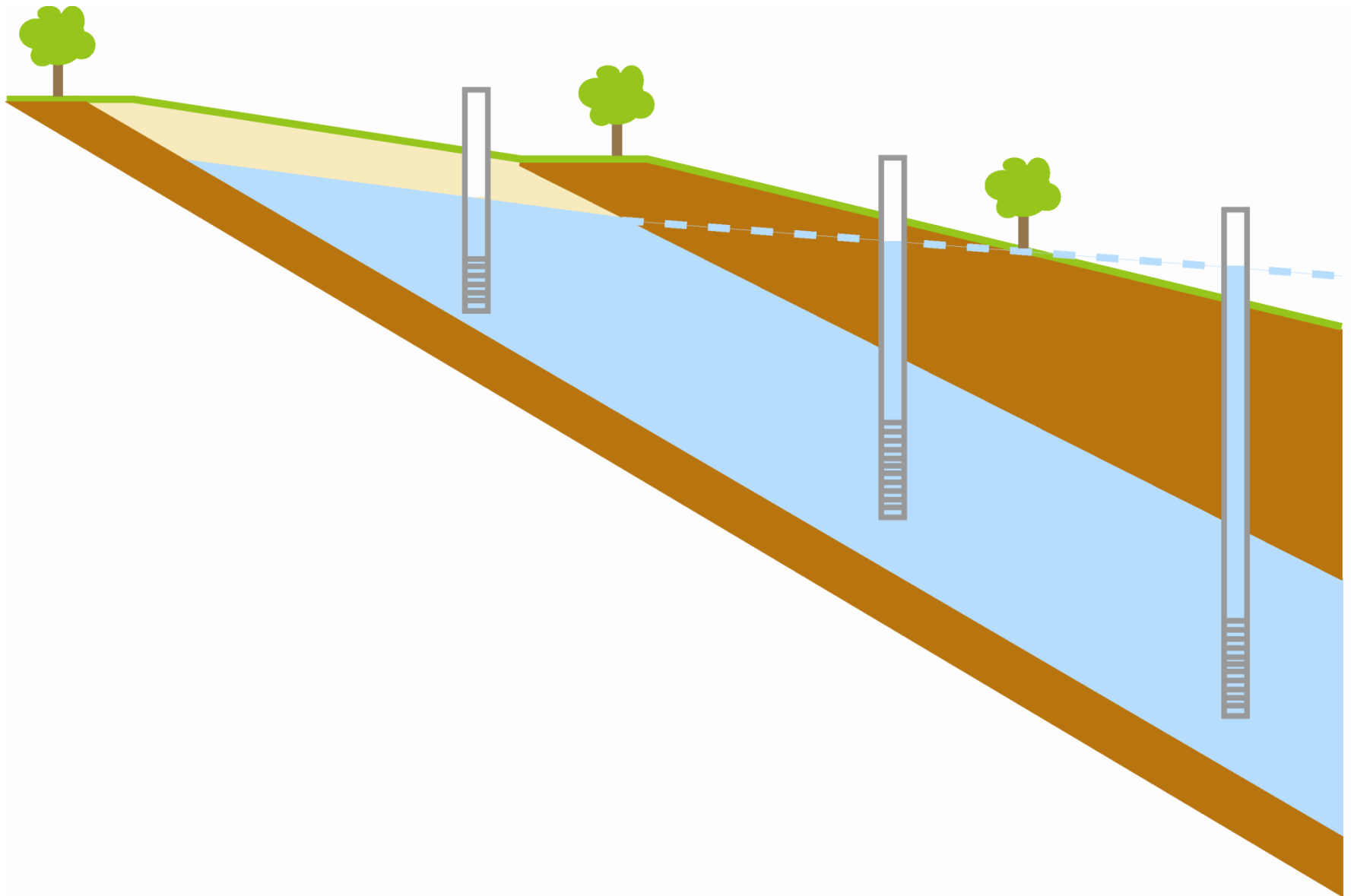


- **What is a flowing artesian well?**
- **History of artesian wells**
- **Artesian water discovered in Texas!**
- **Trouble in Flowville...**
- **Legislation (and lessons learned?)**



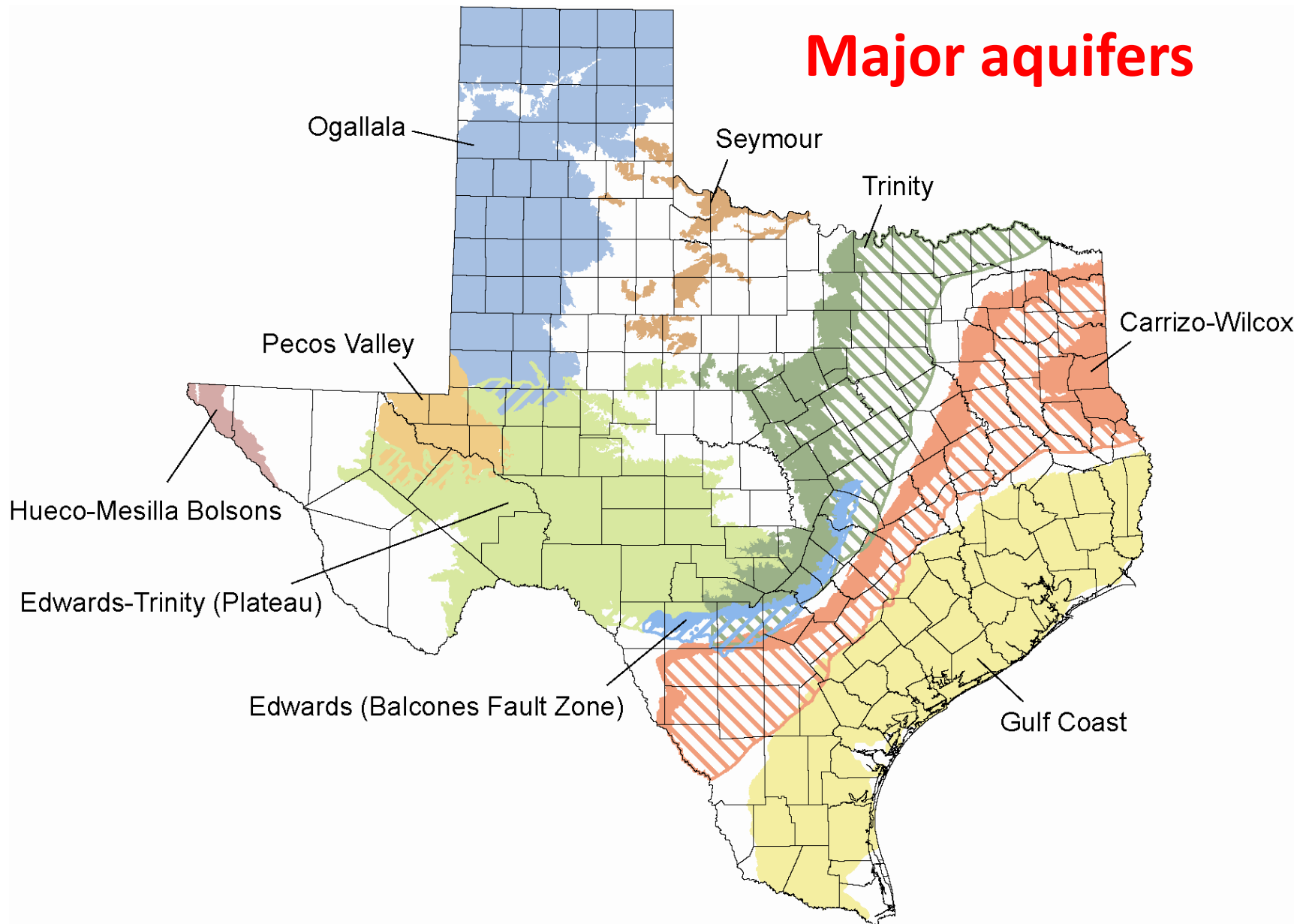
- **What is a flowing artesian well?**
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# anatomy of an artesian aquifer





# Major aquifers





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

# Egypt: 3000 BC

## Egyptian bow drill:

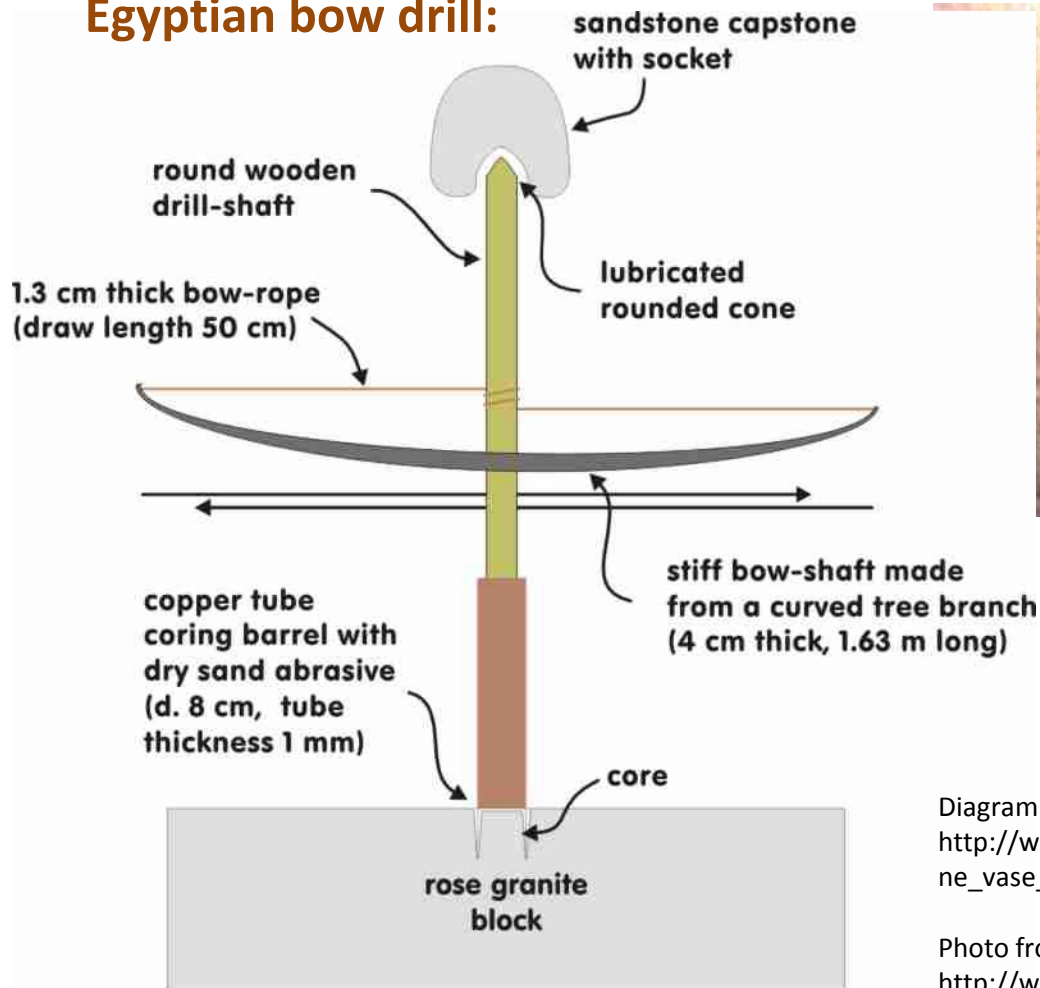
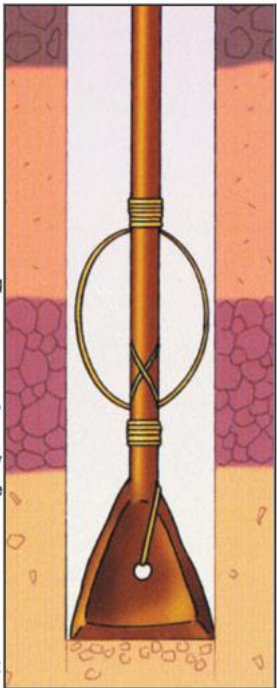
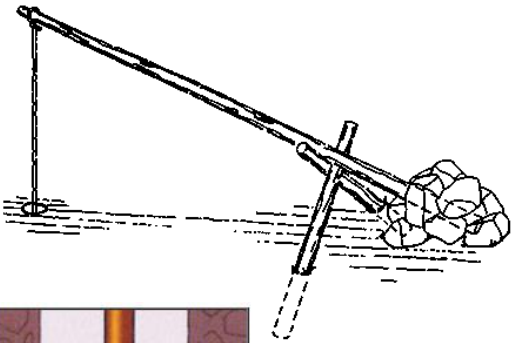
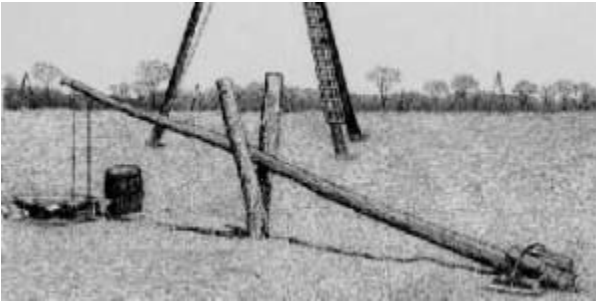


Diagram from  
[http://www.oocities.org/unforbidden\\_geology/ancient\\_egyptian\\_stone\\_vase\\_making.html](http://www.oocities.org/unforbidden_geology/ancient_egyptian_stone_vase_making.html)

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

# China: 300 AD

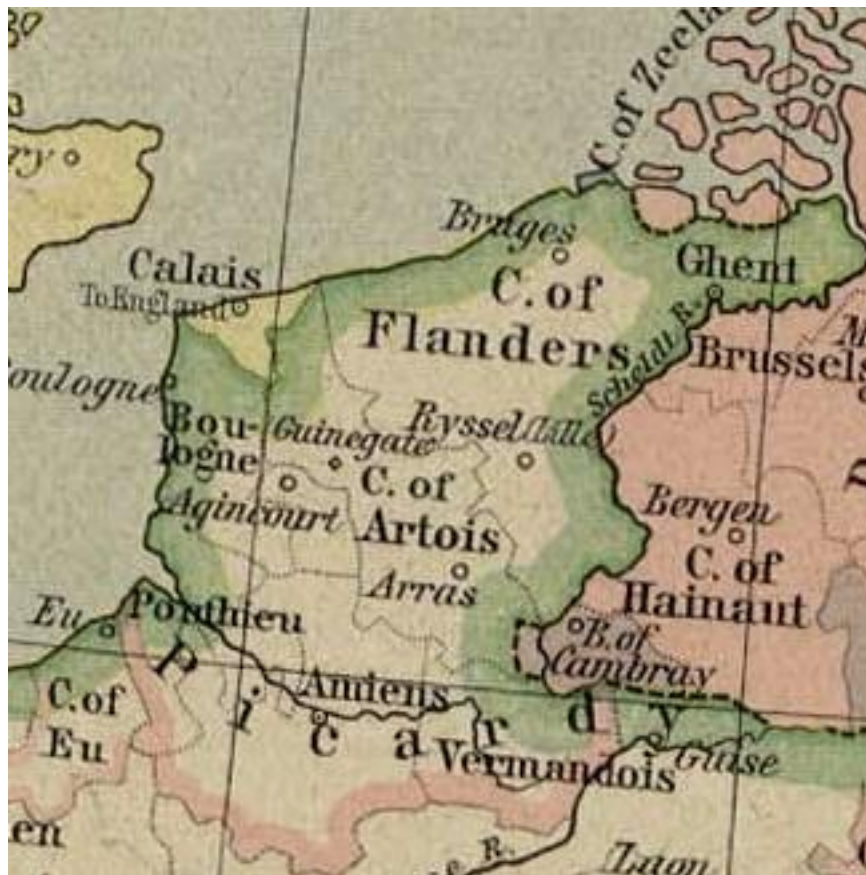


- Early cable tool
- Well casing
- Drilling mud
- 10,000 wells by 1700, some more than 4,000 feet deep

# Carthusian Monks: 1126

## Lillers, France

## Gonnehem, France



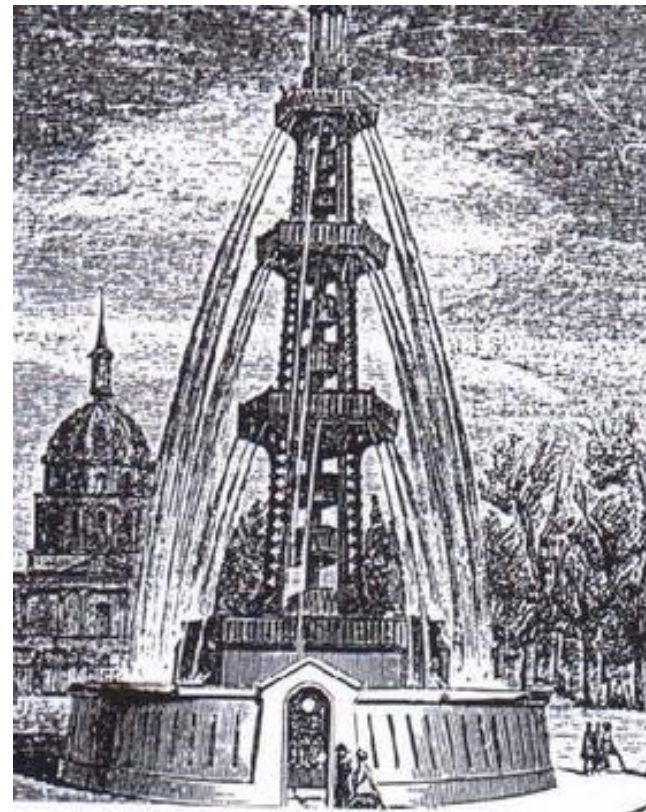
*Province of Artois*





L. J. & C<sup>ie</sup>, édit., Angoulême-Paris

Paris. — Puits artésien de Grenelle



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)



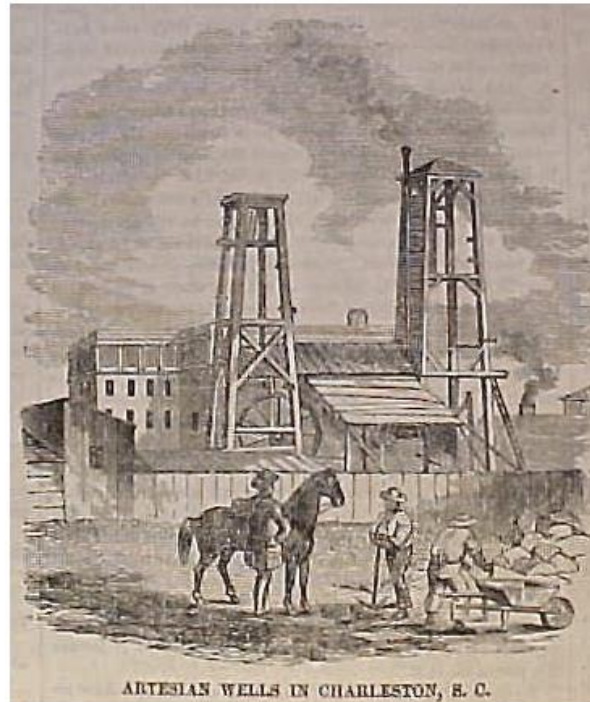
# “First” deep artesian well in U.S.: Charleston, South Carolina, 1854

- Vol Pamph 4-42 1940*
- 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

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, 1874, 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 CISTERN WATERS, AND OF WATERS FROM MANY OF THE WELLS IN THIS CITY.



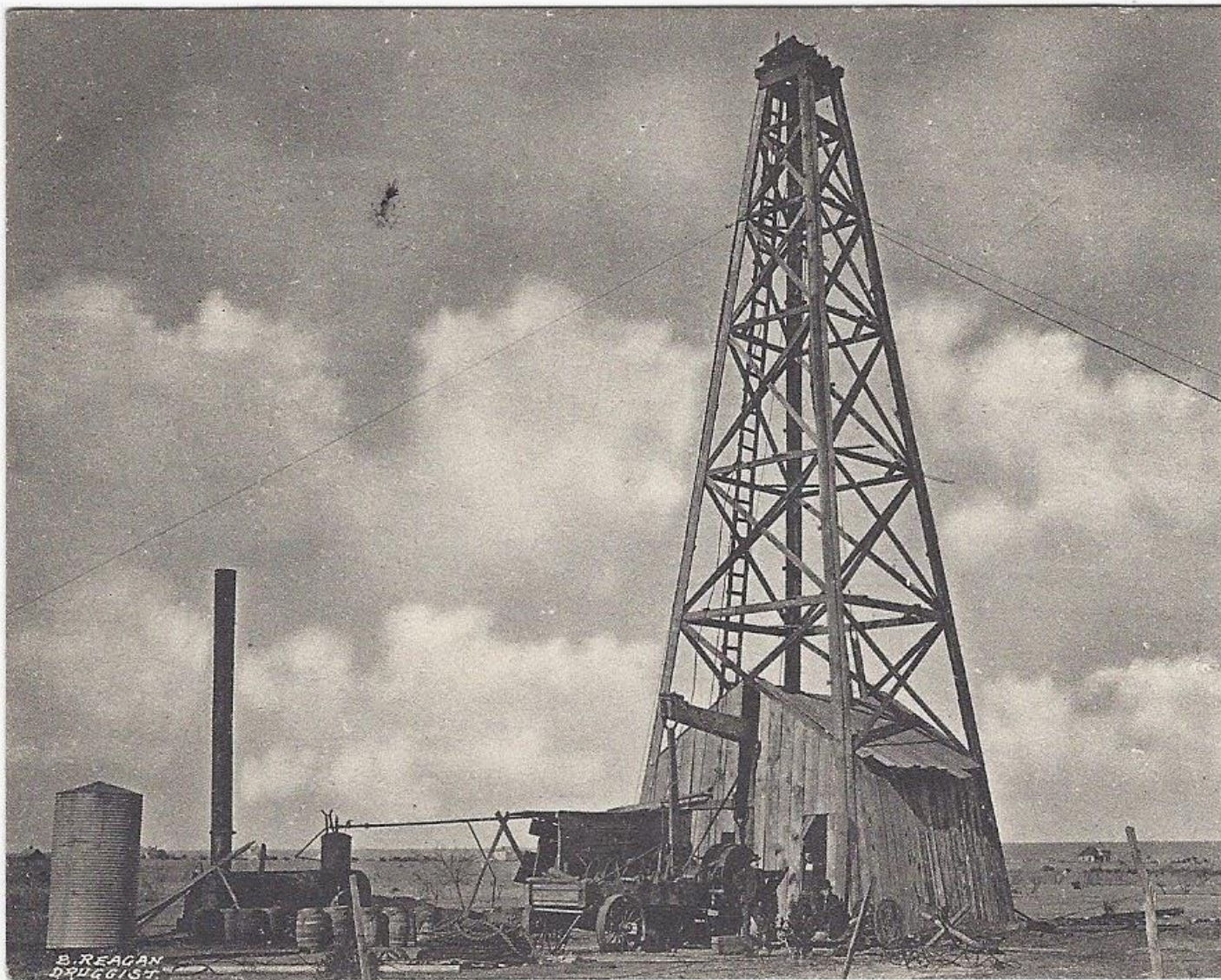
# St Louis, Missouri: 1849-1854

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.

B. REAGAN  
DRUGGIST

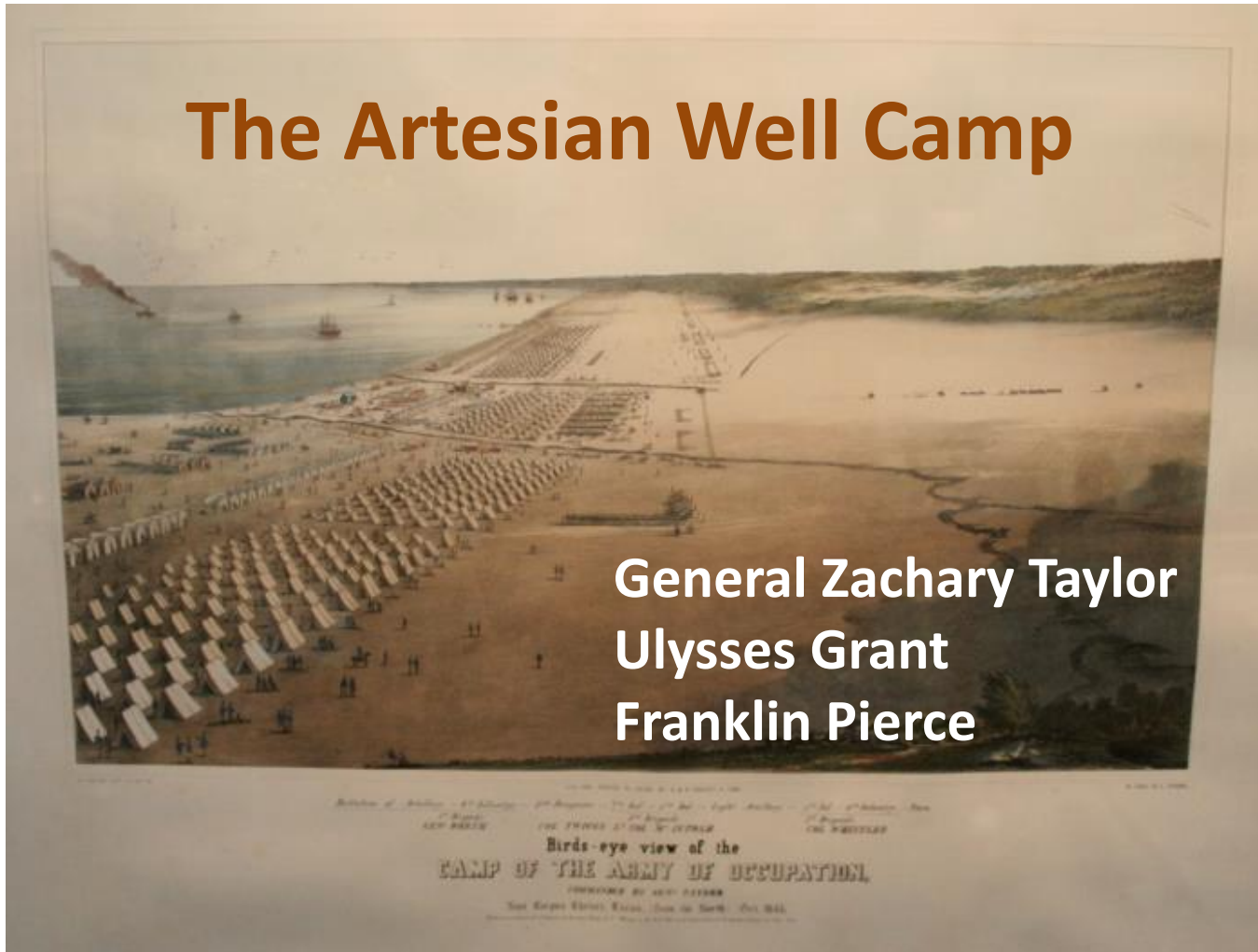


- What is a flowing artesian well?
- History of artesian wells
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- Legislation (and lessons learned?)



# “First” artesian well in Texas: Corpus Christi, 1845

## The Artesian Well Camp

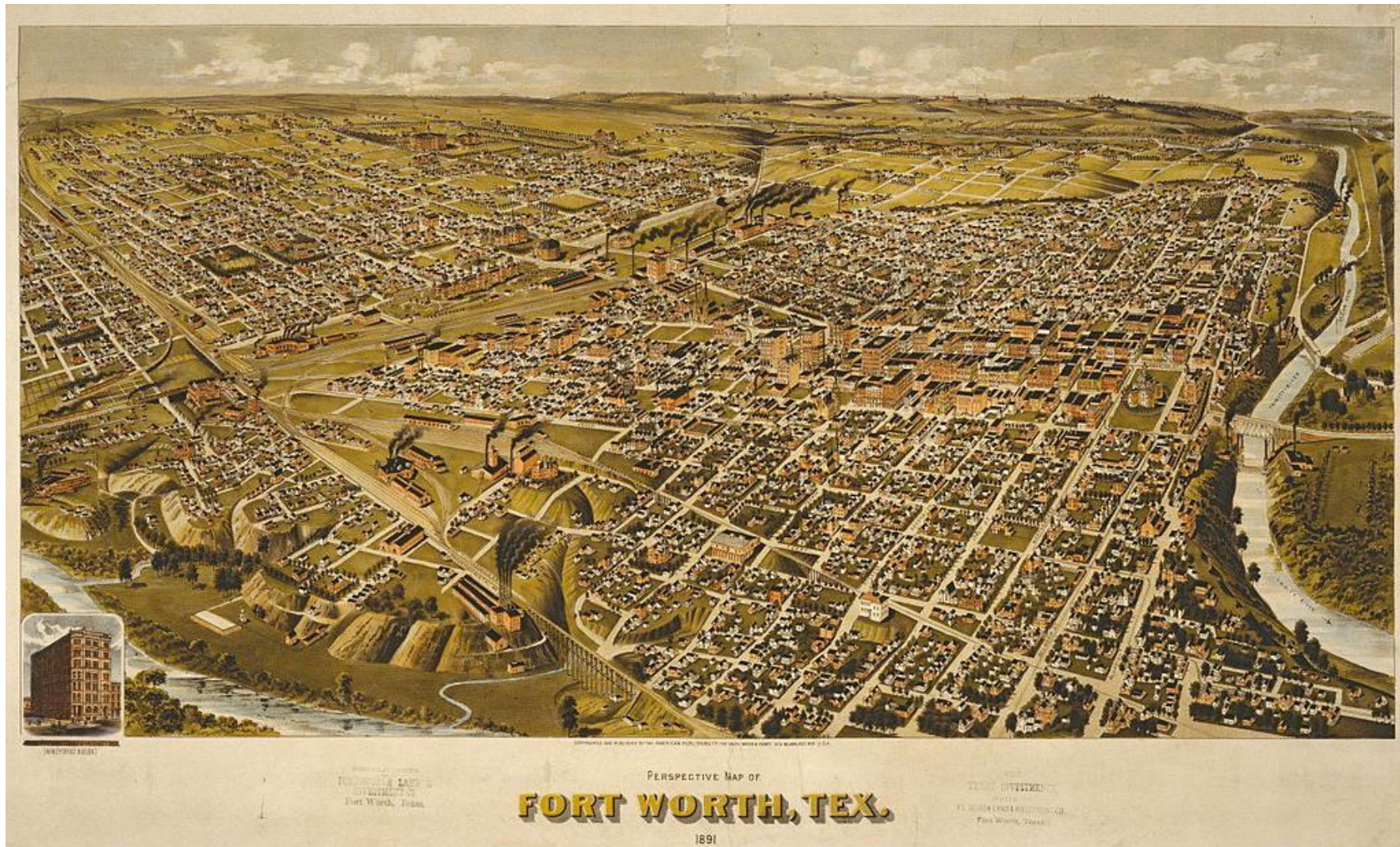


Artesian Square, Corpus Christi, Tex.



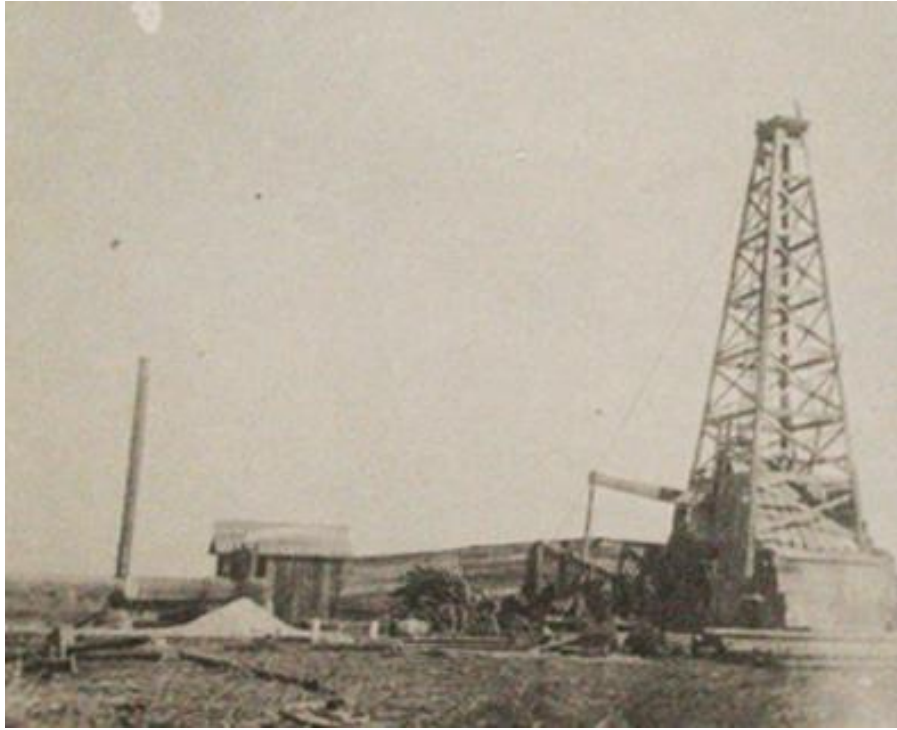


# Fort Worth: 1876



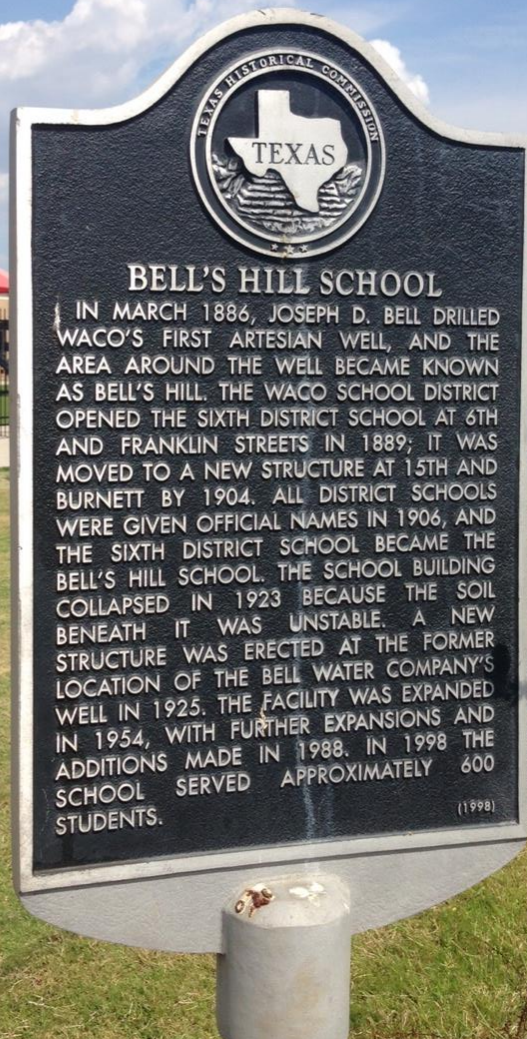


# Bell's Well, Waco, 1886



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







# Artesian MFG & Bottling Co

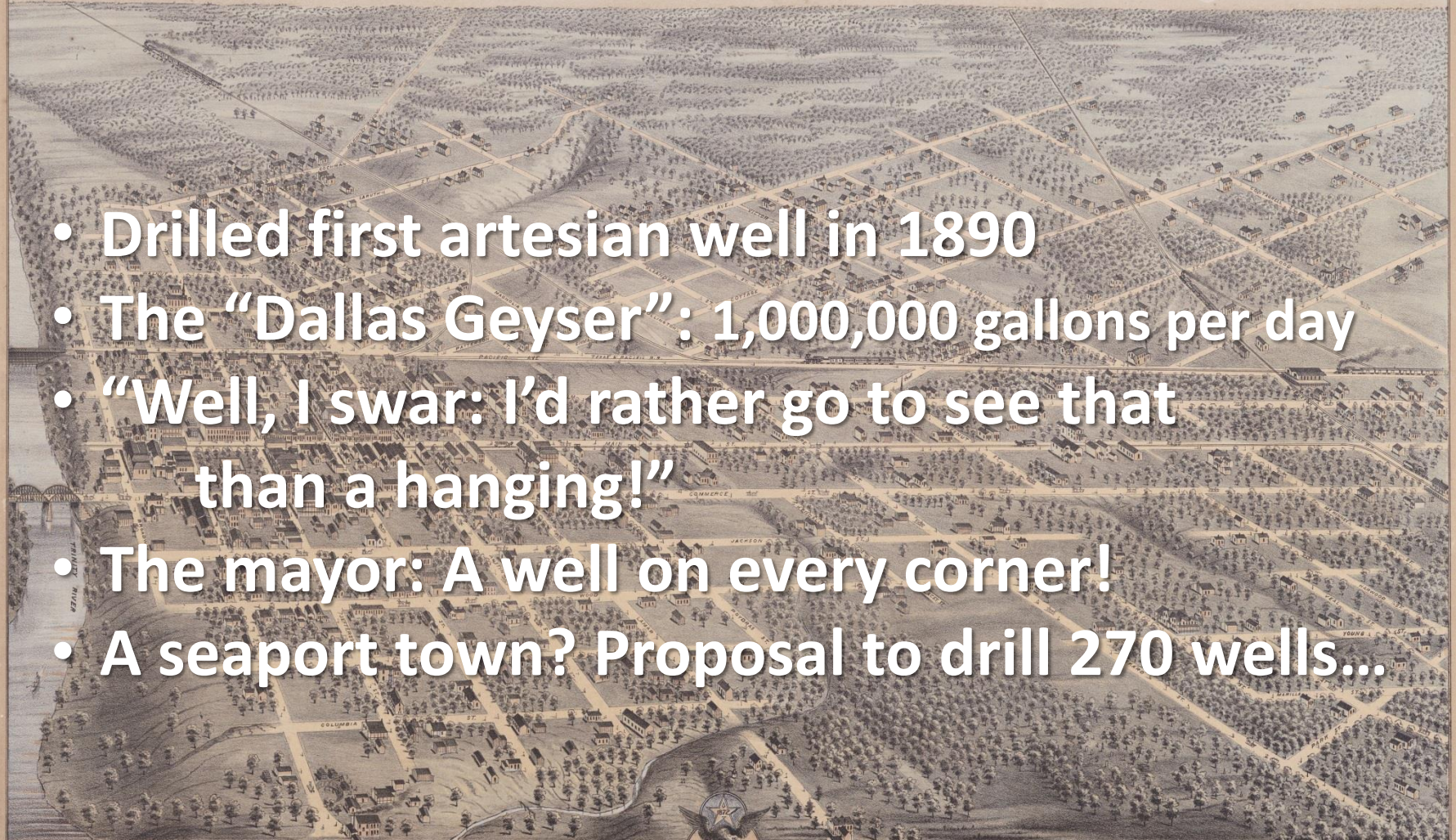
## Dr Pepper





# 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...



REFERENCES:  
N1 Court House  
2 County Jail  
3 Schools  
4 Seminary  
5 Cemetery

REFERENCES:  
N2 Methodist  
3 Presbyterian  
3 Cum. Presbyterian  
4 Episcopal  
11 Christian

Churches

BIRDS EYE VIEW OF THE CITY OF  
**DALLAS**  
TEXAS

REFERENCES:  
10 H. & T. C. R. R. Depot  
11 D. W. R.  
12 D. W. R.  
13 U. S. O. G. T. Hall  
14 Masonic

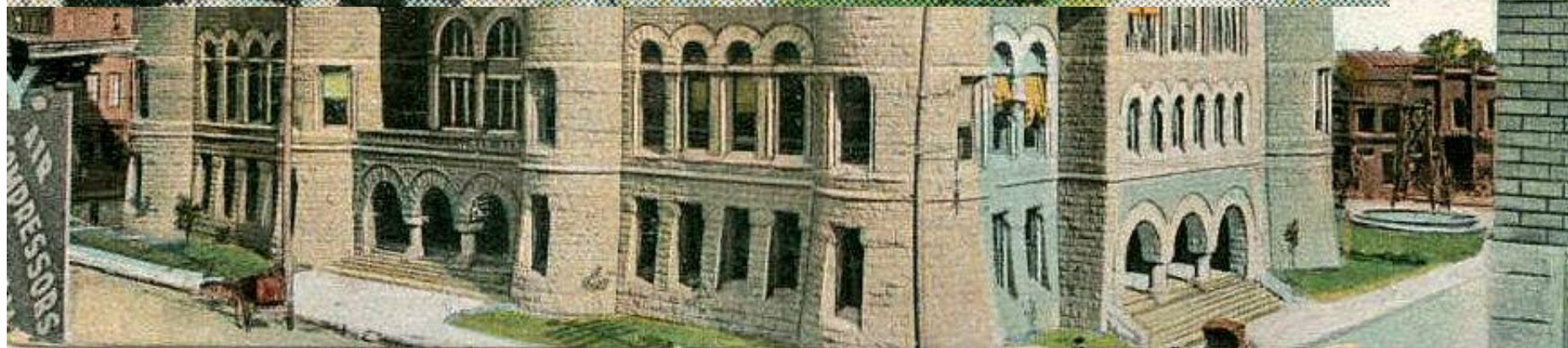
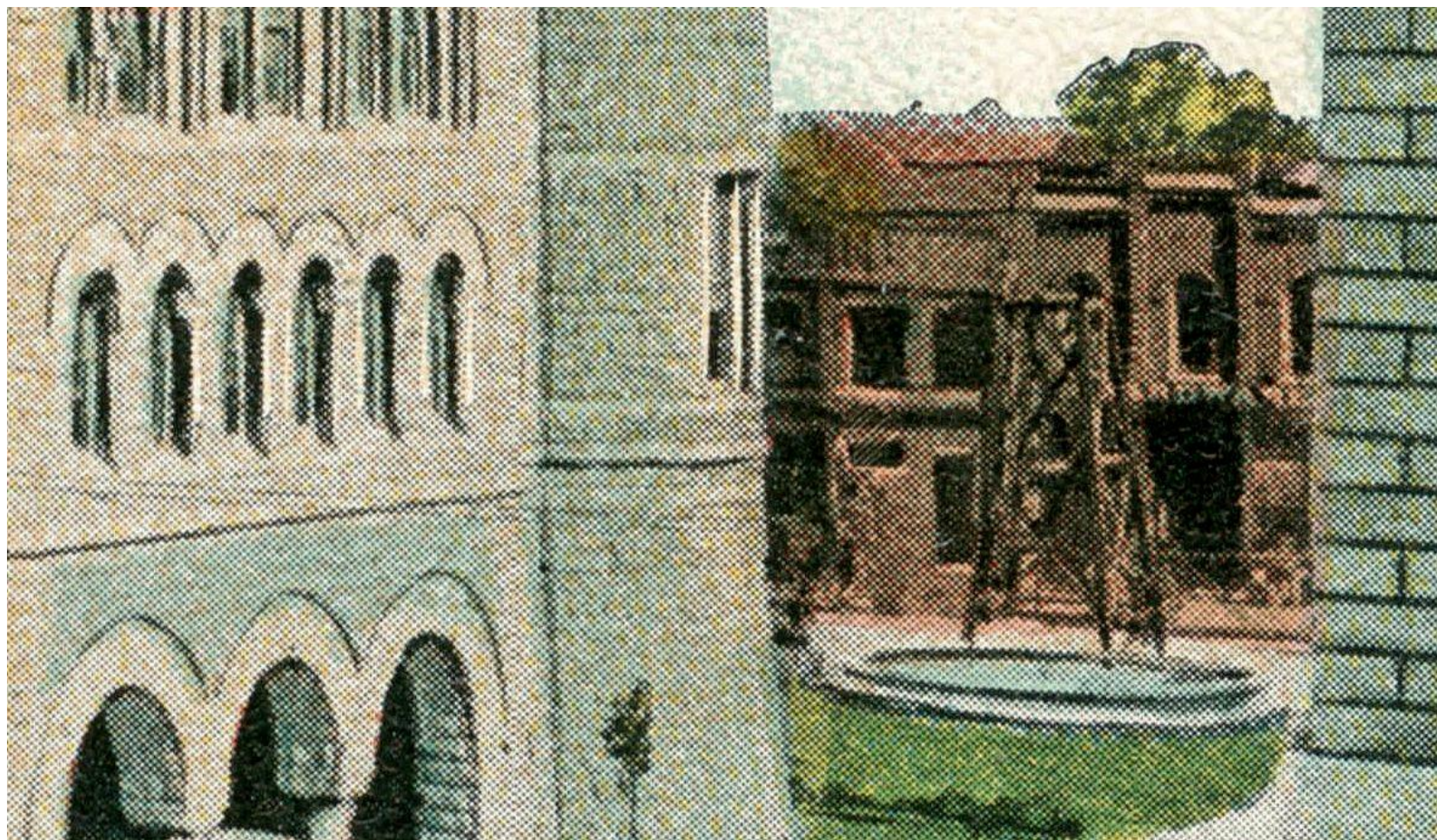
REFERENCES:  
15 Post Office  
16 City Mills  
17 Dallas Herald  
18 News  
19 Breweries

Drawn by H. Brosius





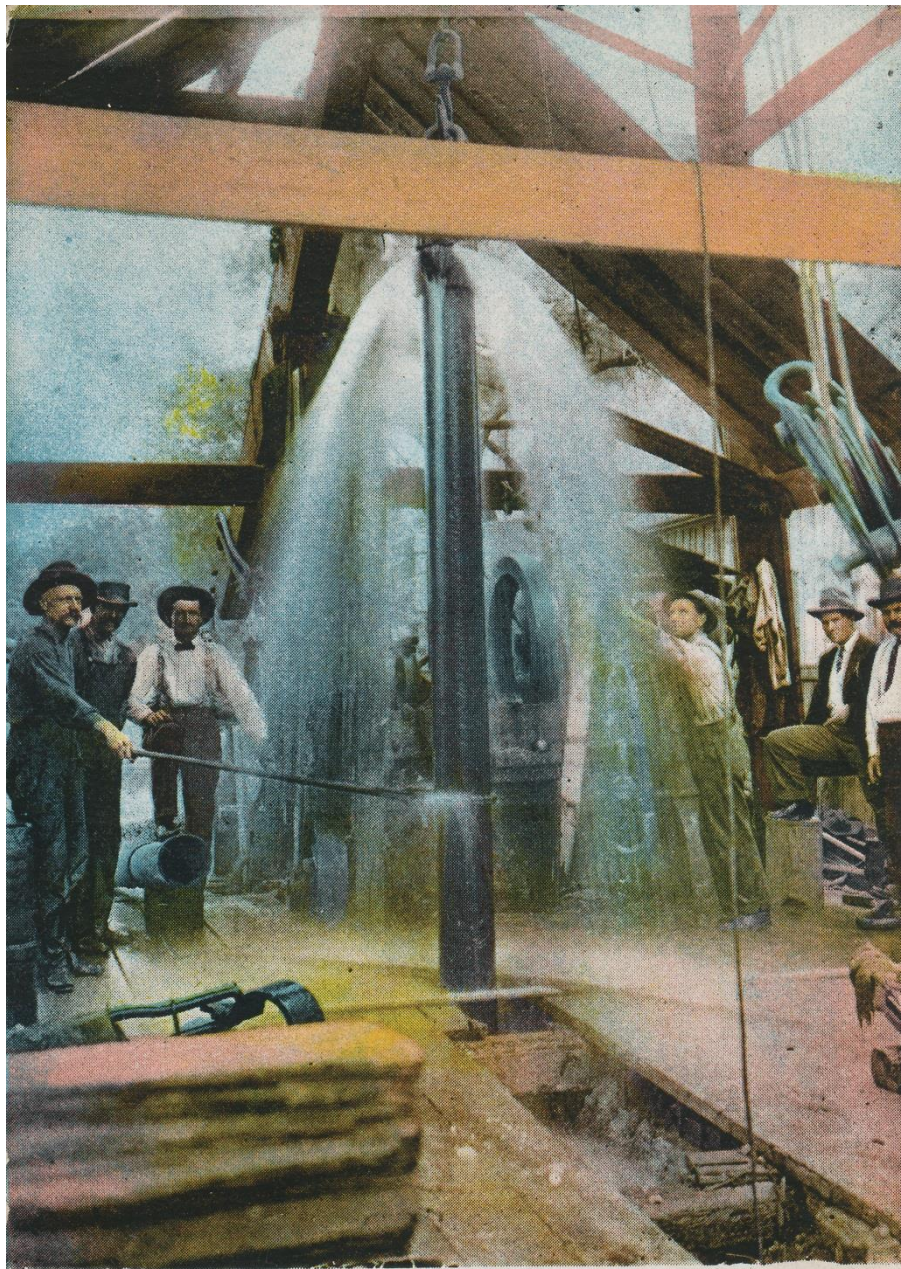
















211882



Flowing Artesian Well,  
Houston, Texas





PECOS VALLEY  
PAINTING CO.

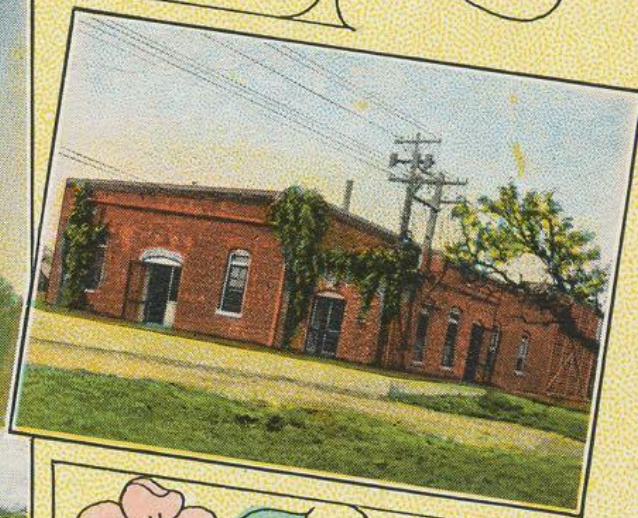
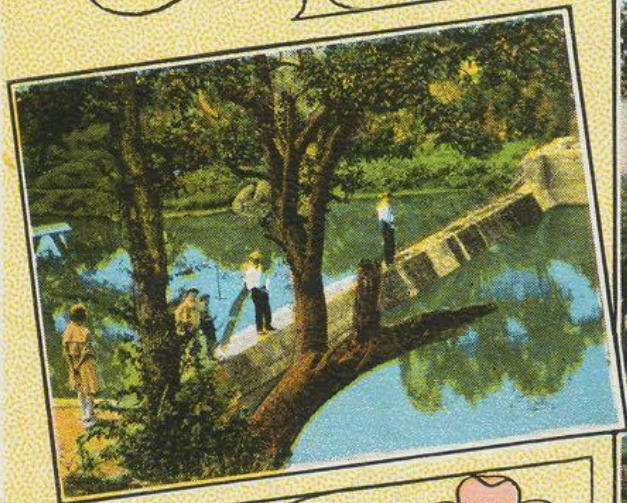
PRODUCTS OF THE PECOS VALLEY





PORT ARTHUR ARTESIAN WELL NO. 1, PORT ARTHUR, TEXAS





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

105105





Testing Rice Well, El Campo, Texas

Published by Our Drug Store

Dear Edwin I will today  
 visiting in a few lines in the  
 hospital as you have been  
 this is the position of a  
 Rice well not very far from  
 here we have a Rice well



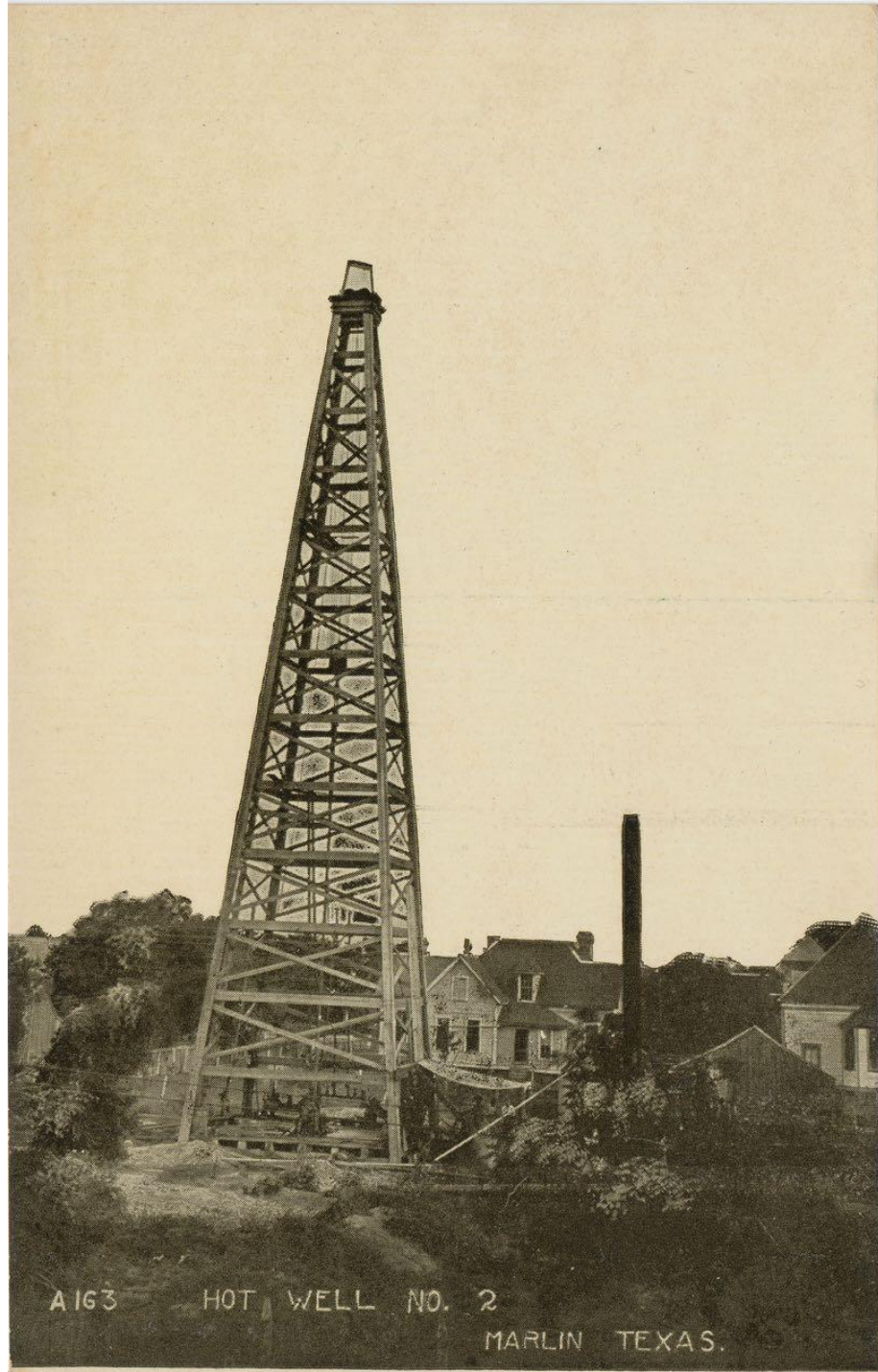




SAN MARCOS, TEXAS.

*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





CHAMBER  
COMMERCE

VICTOR  
REGIONAL  
CHAMBER  
OF  
COMMERCE  
www.victorchamber.com  
(800) 451-1111





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











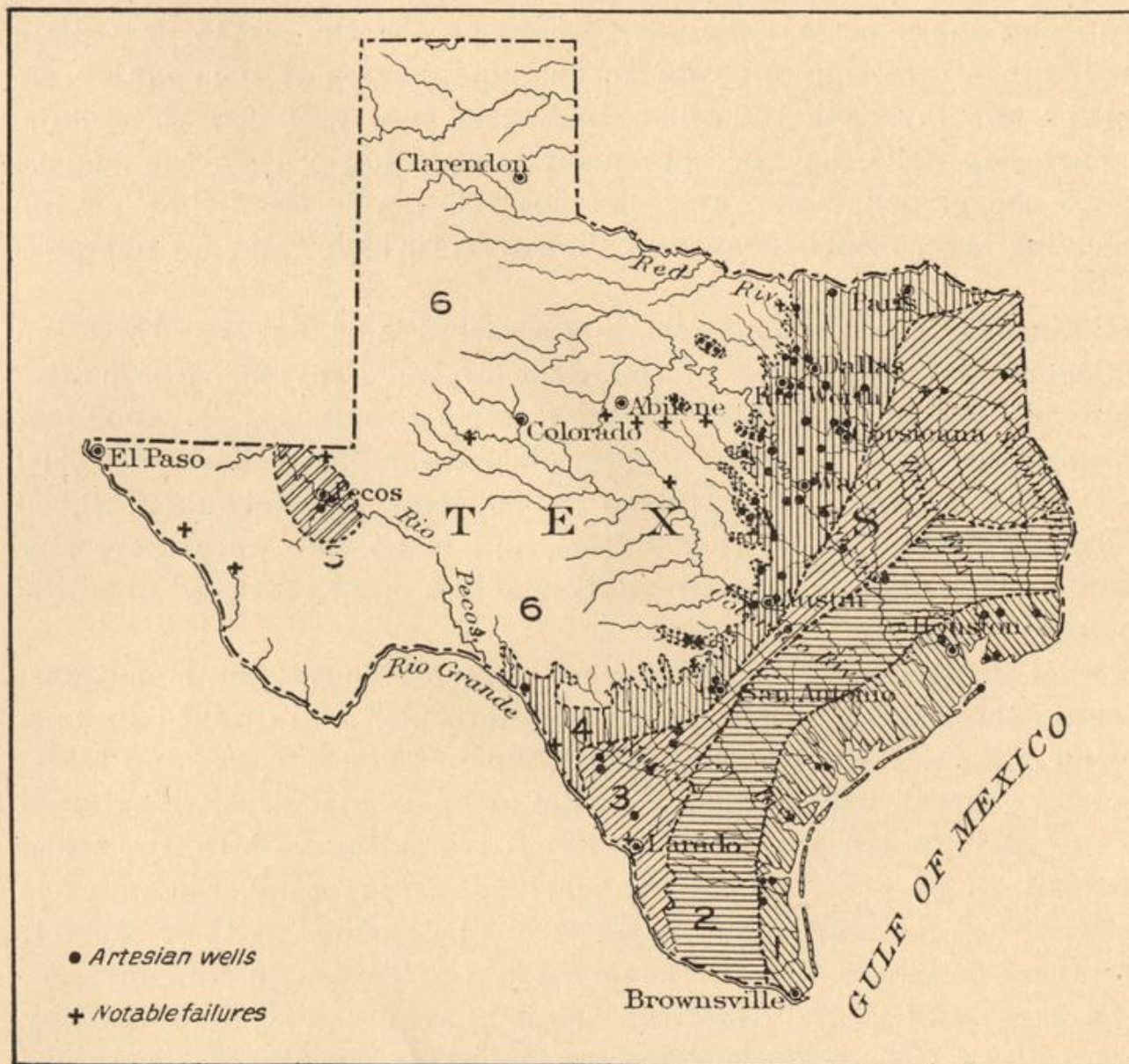


FIG. 44.—Map showing artesian districts of Texas.

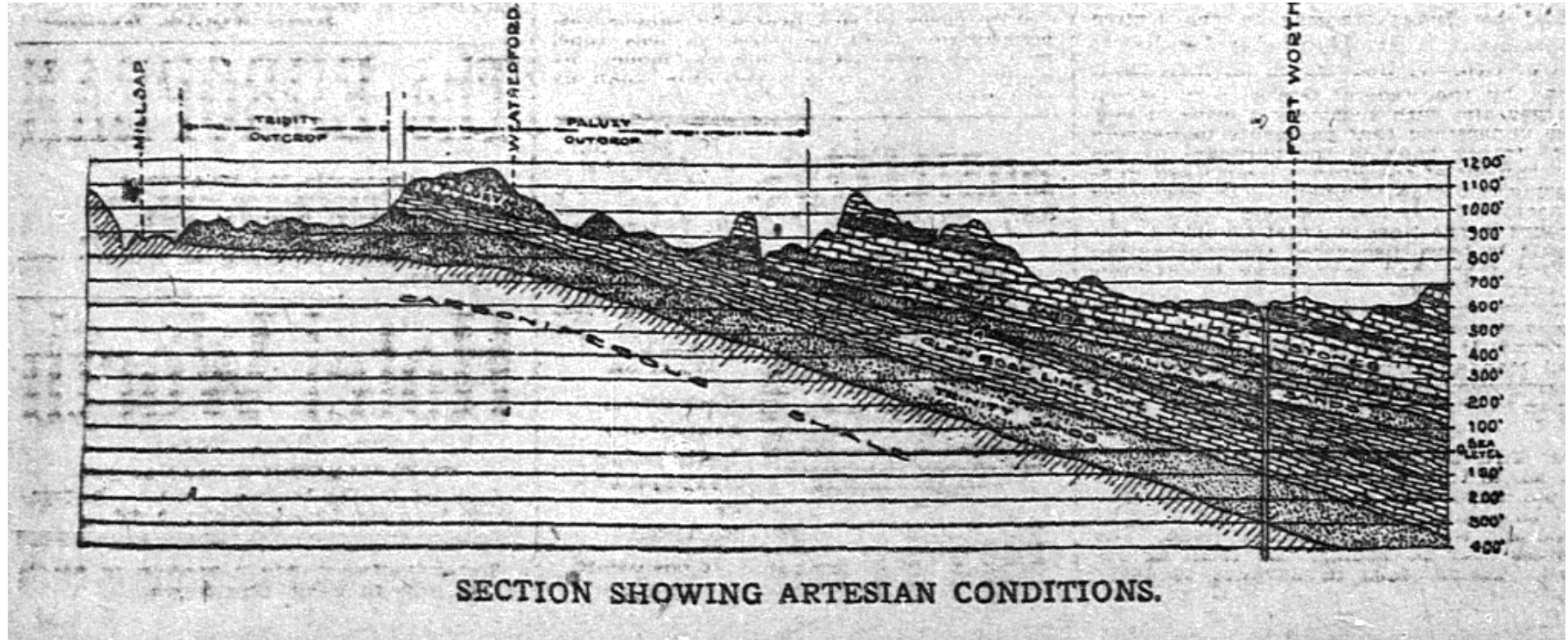
1, Coast Prairie system; 2, Hallettsville system; 3, Carrizo system; 4, Black and Grand prairies system; 5, Trans-Pecos Basin system; 6, Stevens County and Jack County systems.





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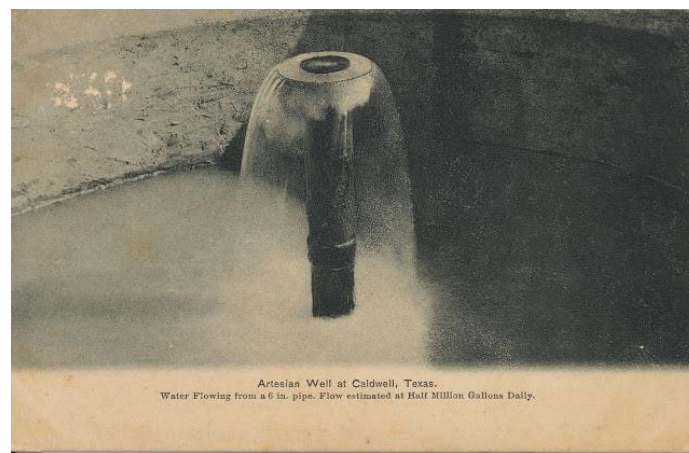
# Where's the water coming from?



- **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...)

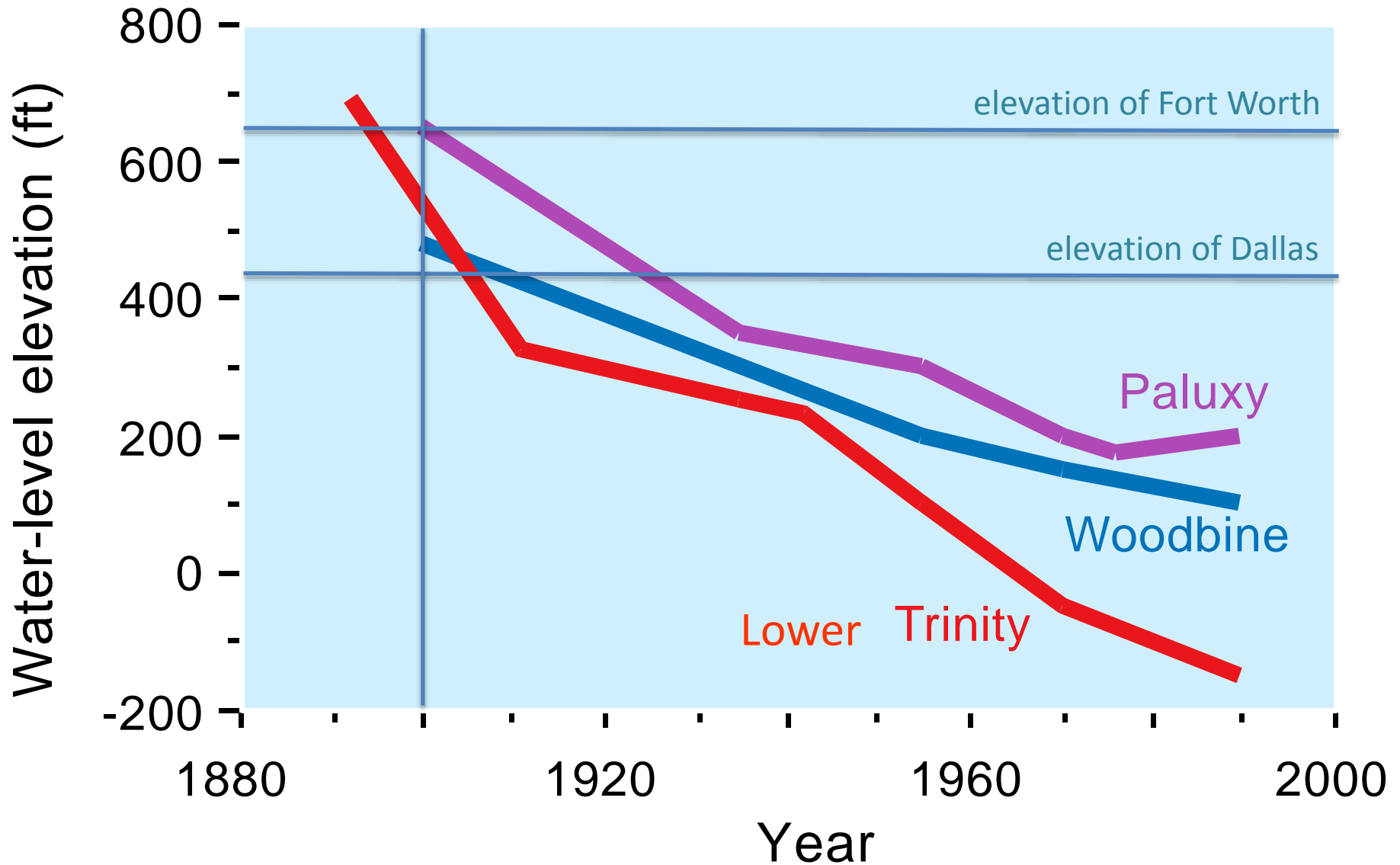


# Flow down!!!



- 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





city sands.

the surface outcrop of occupy a stretch of ally north and south is from five to thirty and west, this out- the northern part of eastern part of Wise central part of Wise and occupying, perhaps, Hood County. n the outcrops of the and is from 50 to 1,300 while the general level out 60 feet above sea and near the water- t above sea level. The n which causes these e low ground, 500 feet

on was that much of was lost in the fric- ough the strata, which d as the amount of h the sand increased. dual loss in pressure or, as the number of quantity of water ob-

of the Paluxy and umerous streams. inity the west fork of a clear fork of Trinity River, with their va- us and branches. On fall the rains of this rains and rivers the ata are received and

of these sandstones is as Geological Survey e miles. This vast g ground which sup- ly water, and its ex- t the permanency and ly.

es have been collected of rainfall, which will conditions and distri- Fort Worth:

1897	1898	1899	1900	1901
65	2.86	3.18	1.75	2.85
73	.98	1.39	.32	1.77
17	2.33	2.72	1.33	1.10
47	8.00	4.28	2.79	6.22
5	5.38	4.84	1.87	7.22
25	.25	1.92	6.01	7.75
47	1.47	1.38	.88	1.39
23	1.80	.31	1.45	3.19
42	2.19	1.19	1.36	3.18
3	1.57	1.56	4.30	...
31	1.75	2.35	2.87	...

u this table that the few years preceding thirty inches. In 1896

disposal of the rain- that it was greatly e. temperature. vege- conditions. These con- h the distribution of ut the year, greatly hich reached the the strata.

rainfall portions, he lows:

nt growth and evapo-

face streams.

e soil and underlying

r flow of streams.

om which plant life

ering the rainfall pe-

h saturates and flows

ata.

varied, he reported,

ns; that from the open

was continually going

ods of rain, when the

aturated with water.

ce of Fort Worth the

e estimated, would be

of thirty inches per

d that if the rainfall

on the surface it was

such conditions the

ceed the total amount

ie free water surfaces

small proportion of the

try, the evaporation

very much less. Dur-

n the air, he said, wa-

apor, and at the time

rsaturated. The rain,

nd, he said, sinks rap-

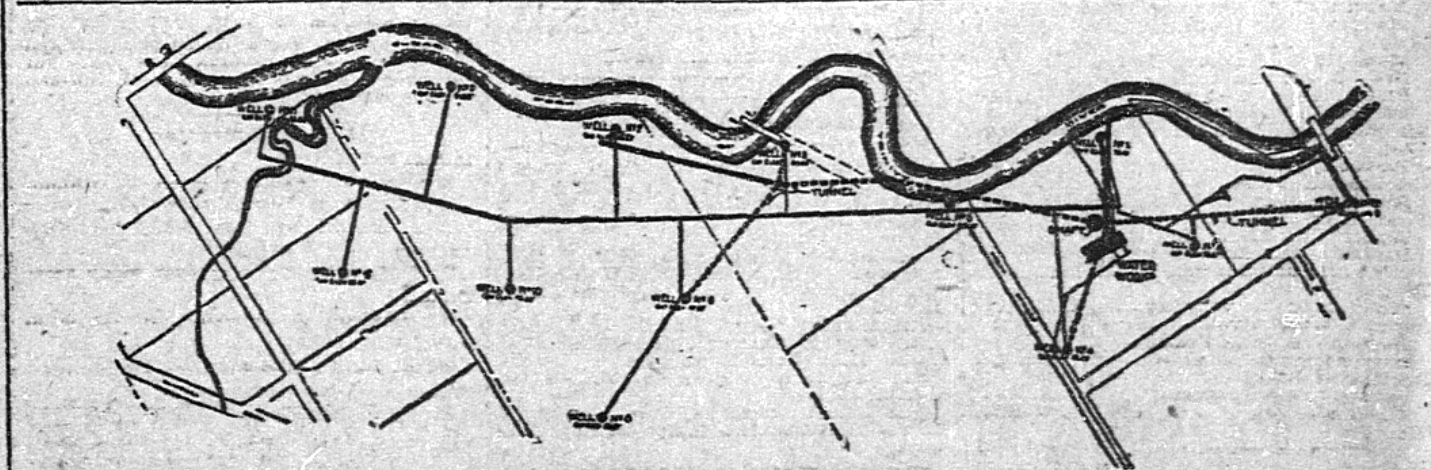
strata encountered, or,

pipe about thirty feet above the He discovered that when released below the surface the wells had flow of about 80,000 gallons a day his immediate conclusion that t feet of head was the amount of necessary to produce the flow. principal involved was that in get pressure or head on the wells m would be produced, hence Mr. M eluded from the experiments mad order to produce a 5,000,000-gallo would be necessary to tap the w 170 feet below the top of the gr pumping the water from this d pressure, he held, was relieved o from the wells and would con produce a largely increased flow. Mr. Mead maintained that it v

CONDENSED IN CASSEMENT

quiro about 250-horse power to r water to the surface, and that co

The work on the new system was com-



ARRANGEMENT OF THE WELLS.

gines provided with steam jackets heaters and are of a very econo sign. They make comparatively and run as smooth as clockwo power is transmitted from the engi pumps by a vertical rope drive of and one-eighth-inch ropes of espe nila transmission rope.

The discharge pipe, which is inches, is connected with the conc ervoir, which is in turn connected suction well from which the mal of the city draw their supply.

There are two drainage pumps w be used in case they are needed t any water that may get into the s shaft is made accessible by a spi case from the surface to the bott

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



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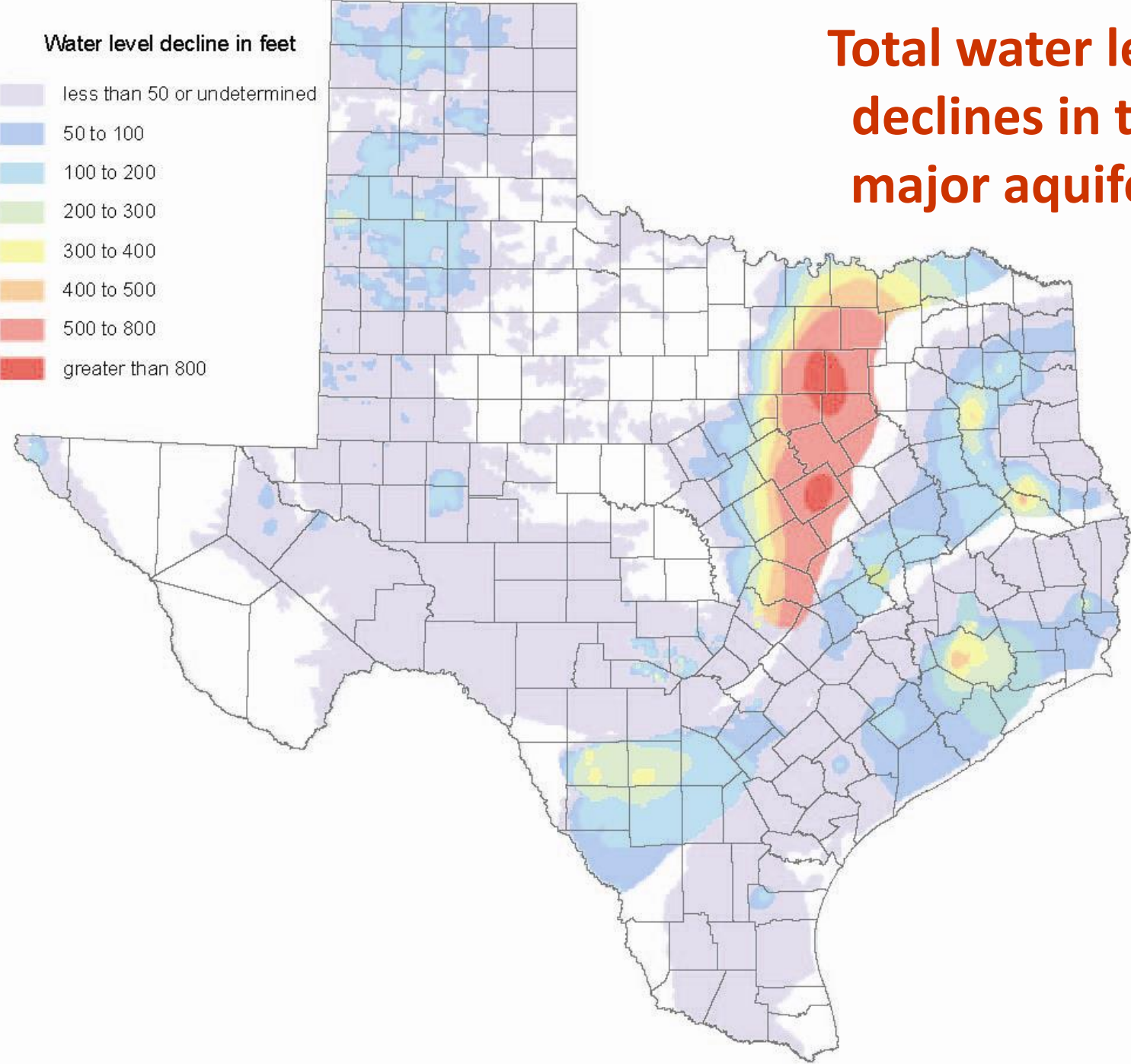


Artesian Well. One of More Than 250 in Pecos, Tex.

# Burges-Glasscock Act 1913



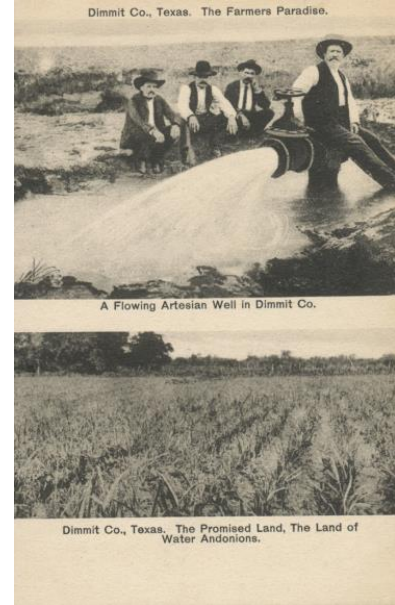
**Total water level declines in the major aquifers**





# 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**





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**robertemace@txstate.edu**