

In Celebration of 75 Years of Oil & Gas
Conservation in Arkansas
*Sexy Oil and Gas Conservation Law:
Where It's Been, Where It's At, and
Where It's Going*

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Where It's Been

Liquid Lighting Fuels 1850s

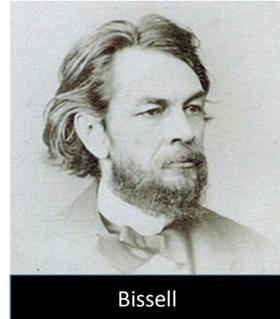
- Whale Oil burned clean but was increasingly expensive
- Coal Oil was less expensive but burned dirty
- Kerosene, developed in 1854 by Benjamin Silliman, a Yale Chemist, for investors George Bissell, an New York lawyer and James Townsend, a New Haven banker, burned clean was initially expensive due to scarcity of “rock oil”



Silliman



Townsend



Bissell

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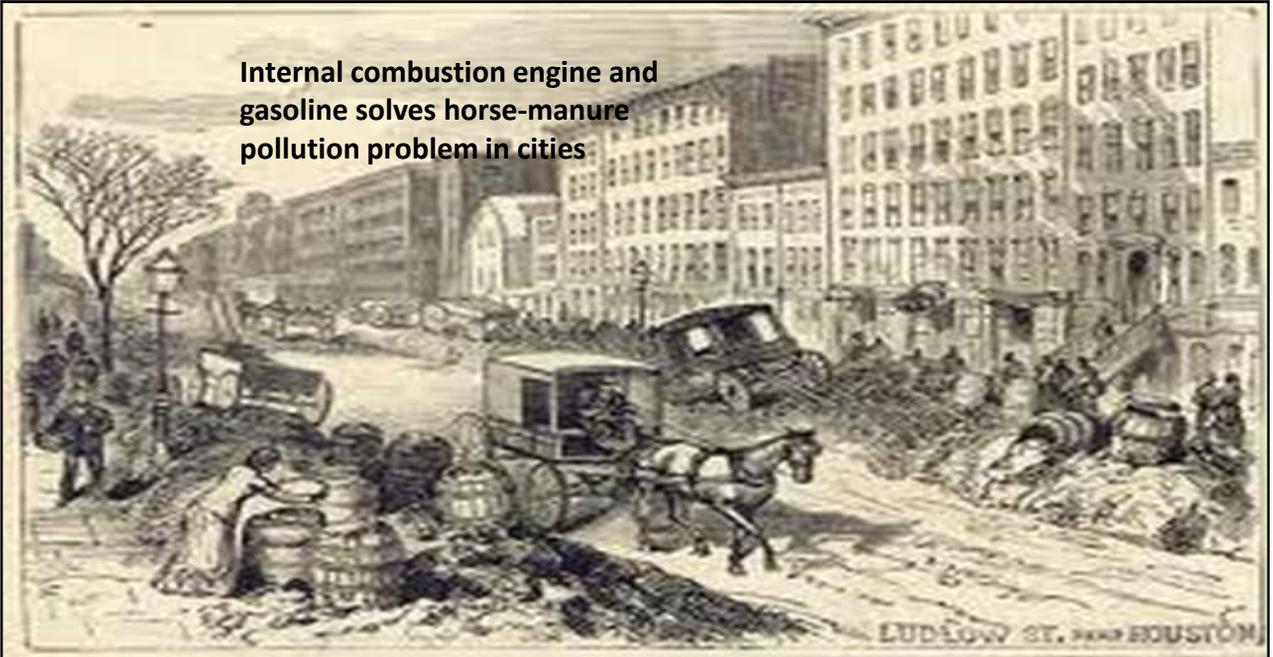


“Col.” Edwin Drake (top hat)
Titusville, Pennsylvania
1859

Pennsylvania Rock Oil Co.,
George Bissell &
James Townsend, Investors

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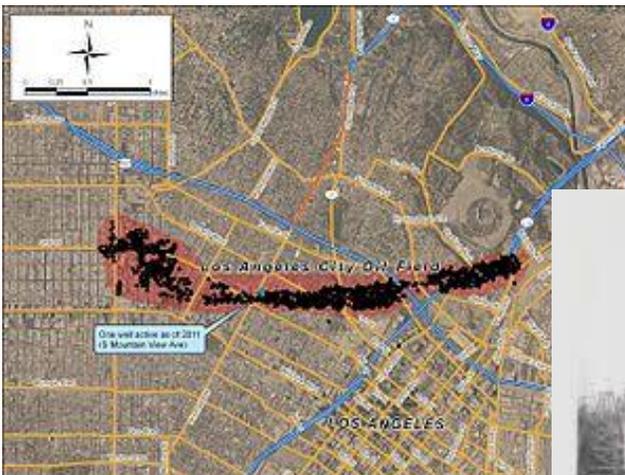
Internal combustion engine and gasoline solves horse-manure pollution problem in cities



Piles of Horse Manure in New York City

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But Oil Conservation Law was late to the dance!



“Up from the ground came the bubblin’ crude!”



Edward A. Clampitt



Edward A. Clampitt

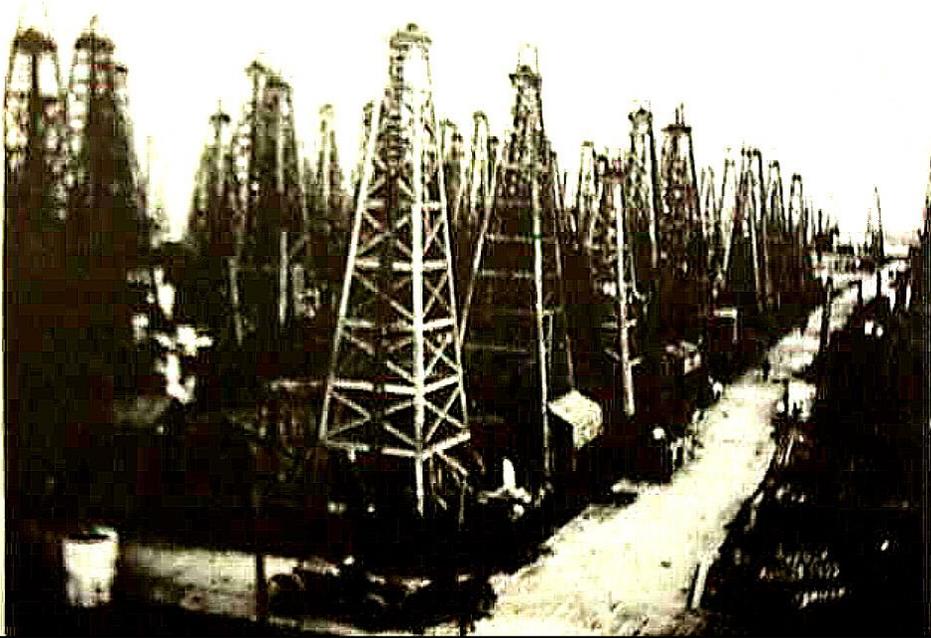


Jed Clampett



Elly May Clampett

SPINDLETOP, TEXAS (1903)



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Conservation was late to the dance!



Edward Doheny



Cerro Azul No. 4

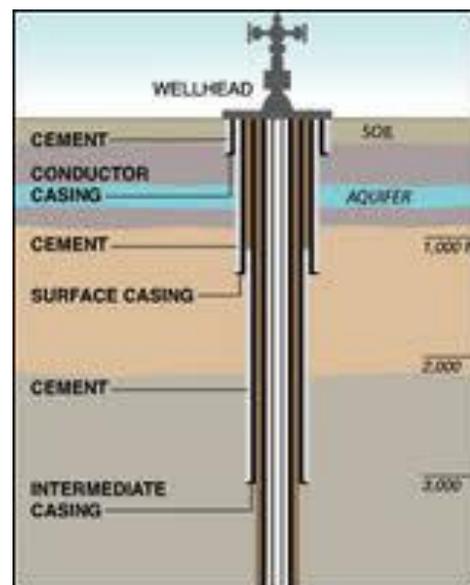
1910s: The growing strategic importance of oil and a concern that world supplies were running out, led to what might be loosely termed “conservation policies”

- President Taft withdrew federal acreage from oil placer locations in 1909
- Great Britain took 51% stake in Anglo-Persian (now BP) in 1914
- Also concerns arose about access to what was left
 - Mexico Revolution (1910 – 1920)
 - Mex. Const. Art. 27 declares sovereignty over petroleum resources
 - Russian revolution 1917
 - Ultimately, leads to loss of assets by Royal Dutch Shell, Nobels, and “Jersey”

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1915: Early Conservation Law

- California requires oil and gas operators to run surface casing below freshwater zones and cemented in place—



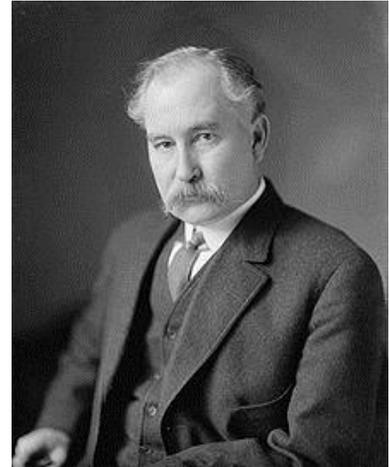
Conservation for national security



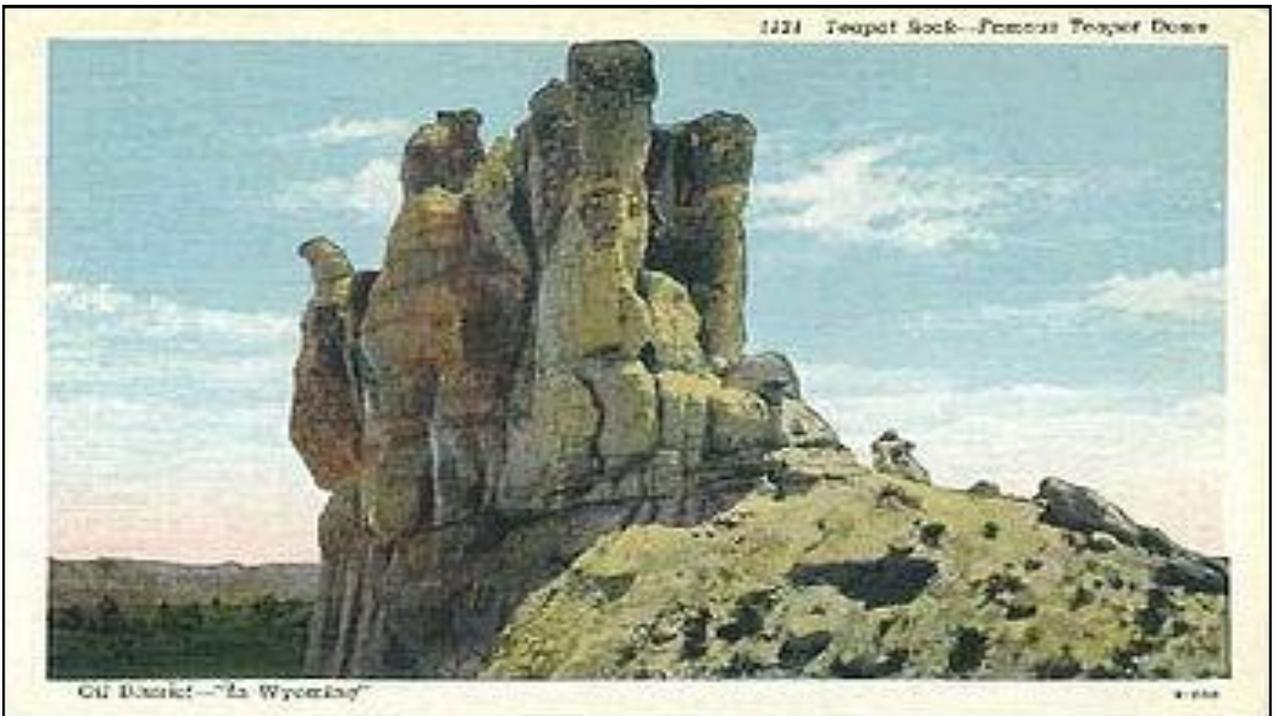
Edward Doheny



Henry Sinclair

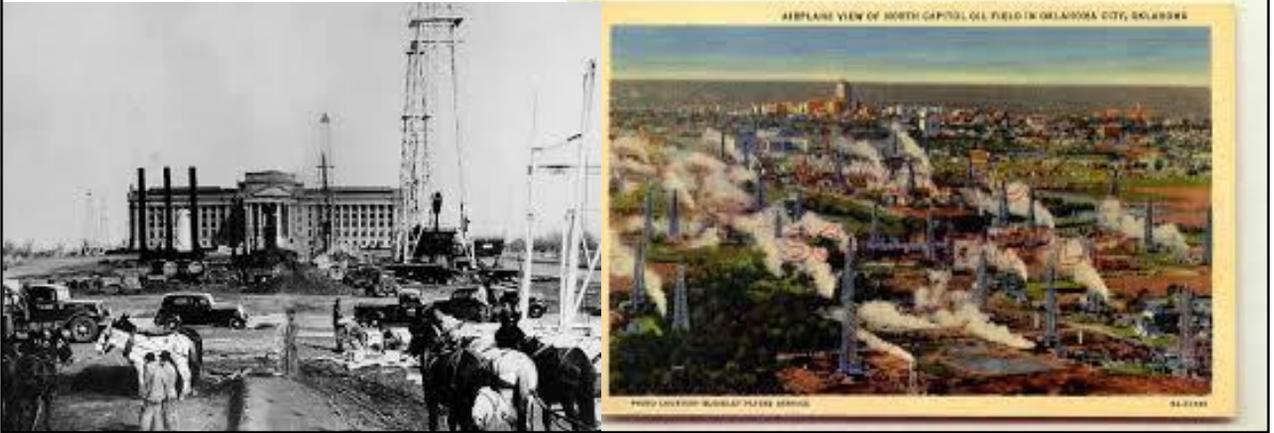


Albert B. Faul



Oklahoma City Oilfield

- Discovered in 1928 and entered city limits in 1930
- Led to well density ordinance of 1 well per city block



1920s World-wide Oil Discoveries

- New discoveries in various parts of the world between 1900 and 1928 raised a concern of oversupply—at least in the short term
 - Numerous discoveries in Texas and Oklahoma
 - Persia in 1908
 - Mexico in 1910
 - Arkansas in 1921 and 1922
 - Venezuela 1922 (some lesser discoveries in 1910s as well)
 - West Texas 1923 (University of Texas trust lands)
 - Oklahoma City 1928
 - Iraq 1928

Conservation by Cartel: The Red Line Agreement, 1928

- Part of a larger agreement brokered by Calouste Gulbenkian to organize the Turkish Petroleum Co. (Iraq Petroleum Co.), a consortium of companies whose modern names are BP, Exxon, Total, and Shell
- The Red Line portion of the agreement prohibited the parties from independently developing oil in the ex-Ottoman empire



Mr. 5%



The Red Line

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Conservation by Cartel: The “As Is” Agreement, 1928

- Product of a secret meeting, disguised as a “golf outing,” at Achnacarry Castle, Scotland, between what we now know as BP, Royal Dutch Shell, and Exxon
- Agreement to limit excessive competition by price fixing and locking in market shares



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1930: East Texas Field Discovery

- East Texas Oilfield Discovered
 - Dad Joiner sold out to H.L. Hunt
 - Hunt had made his initial oil fortune in Arkansas with a borrowed \$50
 - He bought out Dad Joiner without spending a penny of his own money
 - Spawns Hunt Oil, Humble Oil (later acquired by Exxon), and others



East Texas Field Discovery Well: Dad Joiner shakes hands with the portly Doc Lloyd. H. L. Hunt (third from right), who will buy out Joiner, looks on.

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East Texas Production and the Great Depression Seriously Wounded the 1928 Cartel Agreements

- Chaos in the oil industry due to the flood of East Texas Crude
- Prices fell to below 5¢/barrel in 1930\$ [70¢ in 2014\$]
- Some producers and politicians advocated mechanisms to control production and stabilize prices
 - Control was difficult because of the number of small producers
 - Texas Railroad Commission was not authority to regulate production to support prices but it did regulate production to prevent underground waste
 - Oklahoma Corporation Commission had this power but legality was doubtful
- Oil States Advisory Committee, 1931
- Conservation by Martial Law

The Need for Greater Regulatory Control

- “Hot Oil”—oil that was produced in excess of “allowables” mandated by the states was trucked across state borders at night to various refineries
- 1930s was an era of change at the Federal level—increasing federal regulation across all business sectors under the “New Deal”
 - National Industrial Recovery Act (NIRA)
 - Allowed Federal government to set mandatory quota for states and stop hot oil
 - Held unconstitutional by the Supreme Court in 1935

NIRA to IOCC

- The Connally Hot Oil Act of 1935 reinstated the President’s authority under the prior NIRA “to prohibit the transportation in interstate and foreign commerce of petroleum ... produced or withdrawn from storage in excess of the amount permitted ... by any State law.”
 - Included procedural safeguards to address some of the constitutional concerns with NIRA
- Solution to over-production offered by Congressman E. W. Marland: Let states form a Compact under the Compact Clause of the United States Constitution
- The Interstate Oil Compact Commission, formed in 1935, empowered the member states collectively to set production quotas to “reasonable market demand” using federally-supplied supply and demand data

E. W. Marland



Lydie Marland

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Harold Ickes



James Allred



International Government Cartel “Successor” to Red Line, As Is, and IOCC: OPEC founded in Baghdad on September 14, 1960

- Founded in response to lowering of posted price by “Jersey” and other majors
 - Lowered producing government revenues
 - Seven Sisters produced about 90% of Middle East oil
 - Founding members: Iran, Iraq, Kuwait, Saudi Arabia & Venezuela
- OPEC, in the 1970s, began a production quota system for its member states that is somewhat like market demand prorationing
 - OPEC did this unabashedly to support oil prices!

Where It's At:

- Modern conservation acts, modeled after the New Mexico and Arkansas acts
- Purpose: Prevent Waste & Protect Correlative Rights
- Through:
 - Spacing and density regulations
 - Exception locations
 - Compulsory pooling
 - Production restrictions to prevent waste and protect correlative rights (and in some states, limiting production in light of “reasonable market demand”)
 - Strict drilling, casing, cementing, plugging, and abandonment regulations
 - A few state conservation agencies (e.g. Michigan) have power to balance oil and gas conservation with other priorities, such as environmental protection

The “small-tract” problem

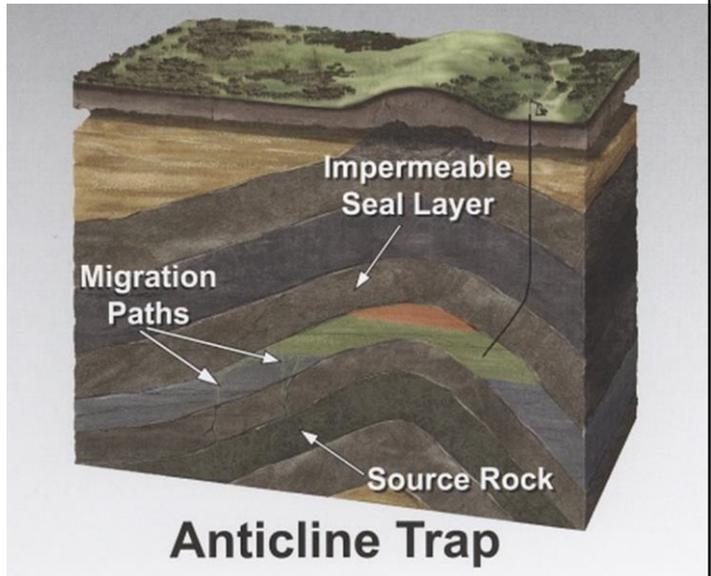
- New Mexico and Oklahoma: first states to have comprehensive compulsory pooling statutes in 1935
 - Michigan (1937) and Arkansas (1939) were not far behind
 - New Mexico adopted the practice of requiring the consenting parties to carry the non-consenting parties, but subjecting the non-consenting parties’ working interests to a risk premium (similar to JOAs)
 - Oklahoma adopted the practice of appraising the working interests of non-consenting parties, whereby force-pooled non-consenting parties transferred their working interests in a pooled unit to the consenting parties in return for cash and perhaps an overriding royalty
- Texas adopted a practice of granting small-tract exception-location wells “to prevent confiscation,” coupled with a “living allowable” but eventually enacted a limited pooling act
- Kansas adopted the practice of granting small-tract exception-location wells, without a disproportionate increase in allowables, but did permit small tracts to voluntarily pool, including non-contiguous acreage, overlying the common reservoir, in order to gain an increased allowable

Unitization

- Harold Ickes was a strong advocate of unitization in the 1930s
- In 1945, Oklahoma passed a compulsory unitization law
 - Others, including Arkansas, followed in the 1950s and early 1960s
 - But Texas still has no compulsory unitization act
 - Curiously, Kansas has a compulsory unitization, but not compulsory pooling
 - Alaska: only state that has a compulsory unitization act that does not require some minimum % of voluntary agreement to empower its conservation commission to order unitization
- Federal regulation authorizes “exploratory unitization” as does the latest IOGCC Model Conservation Act (2004)

Conservation Law Evolved for “Conventional” Petroleum Development

- Porous reservoir rock capable of holding commercial quantities of petroleum
- Permeable reservoir rock that allows petroleum to flow through the rock
- Petroleum is held in place by rock that traps the oil in place



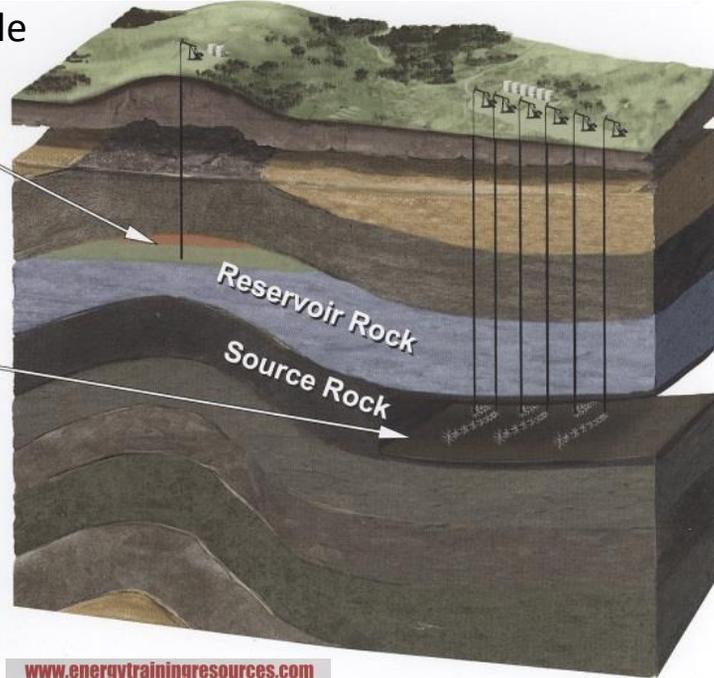
Where it's going (or needs to go):
 “Unconventional” Petroleum

- Petroleum still in its source rock—rock that is porous but not very permeable, e.g., shale
- Petroleum in a trap that is “tight” —without sufficient permeability to allow flow, e.g., tight sand
- Petroleum located in locations that are very expensive to tap, e.g., deep water
- Petroleum of a quality that does not permit production through traditional drilling, completion, and production techniques, e.g., oil sands

Unconventional Shale

Conventional Trap
Oil and Gas Migrated
from Source Rock and
Accumulated in a Trap
in Porous Rock

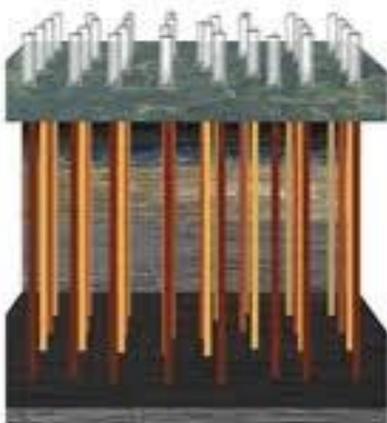
Unconventional
Producing from Source
Rock (Shale) with
Low Oil and Gas
Concentration, Poor
Porosity and Terrible
Permeability using
Horizontal Drilling and
Multi-Stage Fracturing



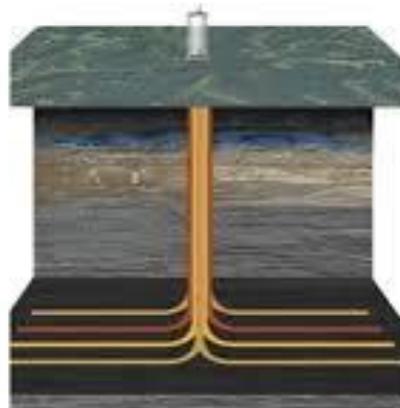
Shale and Tight Reservoirs

- In a sense, these reservoirs turn conservation policy on its head
- “More wells, more oil”—Rule of Capture and early conservation practice
- “Fewer wells, more oil”—Post WWII conservation practice
- “More wells, more oil”—shale and tight reservoirs

Belridge Oil Field, Kern County CA



Traditional Vertical Well Spacing:
32 Separate Pads/lines Needed For 32 Wells.



Identical Horizontal Well Spacing:
1 Pad/line Yields Up To 32 Wells.

Biggest Conservation Challenge?

Responding to, without stifling, new technology

Most conservation agencies have done a commendable job, although statutory constraints are a problem in a few states



The Big Three Old “New” Technologies

- Horizontal Drilling
- 3D Seismic
- Hydraulic Fracturing

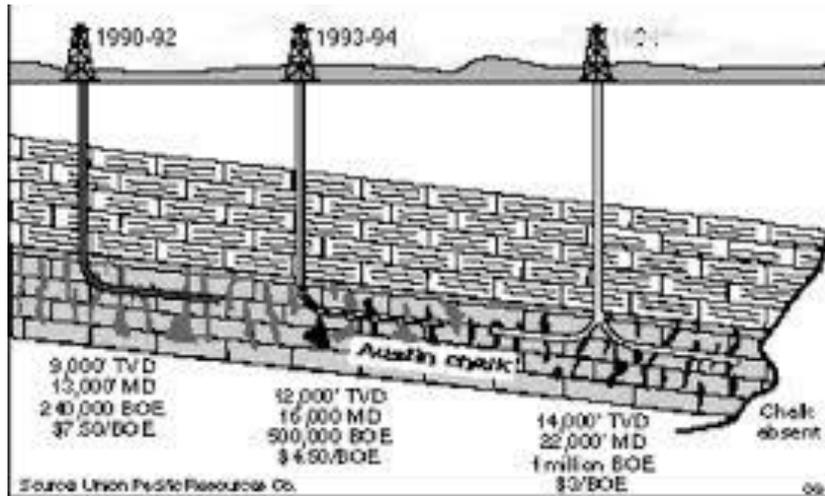
Slant to Horizontal Drilling

- 1920s: several lawsuits alleging that wells had been slant drilled to trespass beneath neighboring property, helped develop technology to measure a wells angle and location
 - Gyro compasses improved such measurements, developed by Sperry Corp. under contract to Sun Oil company, but spun off into Halliburton
- 1934: H. John Eastman pioneered directional drilling to control a well fire in the Conroe oil field in Texas
- **1970s:**
 - Downhole drilling or mud motors, driven by the hydraulic power of drilling mud circulated down the drill string, allowing the drill bit to continue rotating, while most of the drill pipe remained stationary
 - Measurement while drilling tools (MWDs) and rotary steel systems (RSS) allow the drill bit to be laterally directed as desired

Austin Chalk

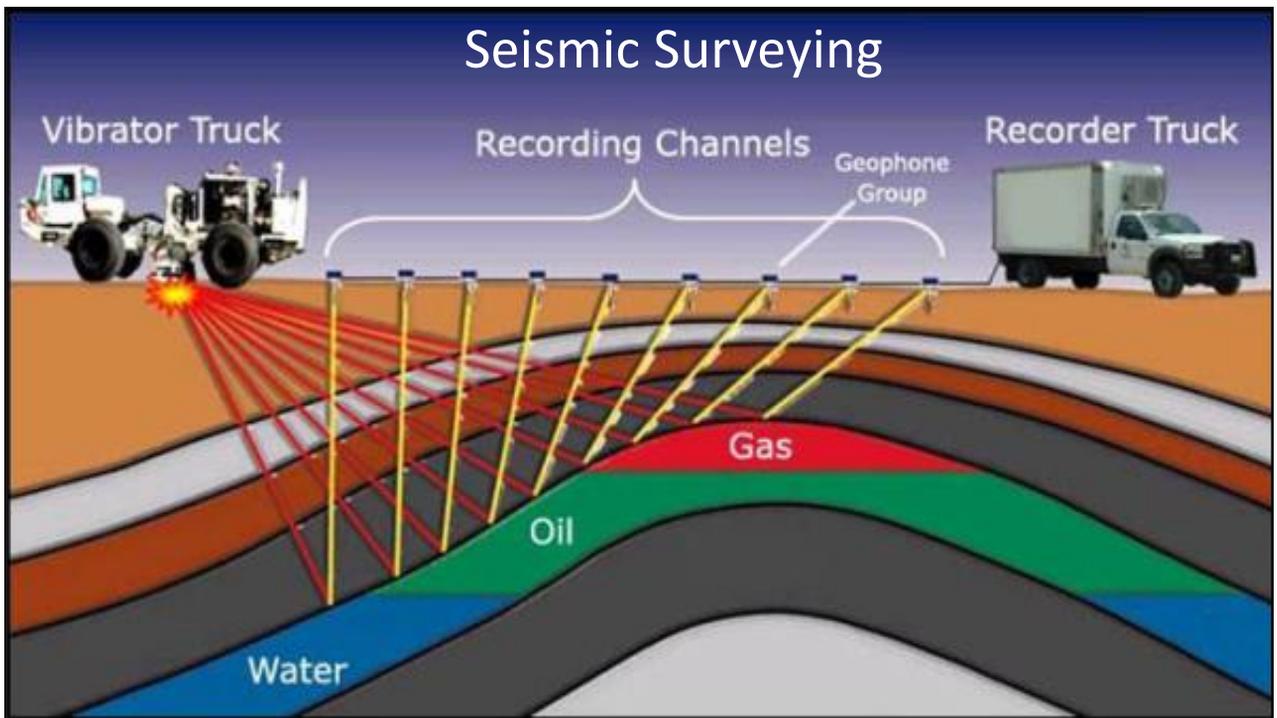


Austin Chalk Horizontal Drilling Using MWD Tools

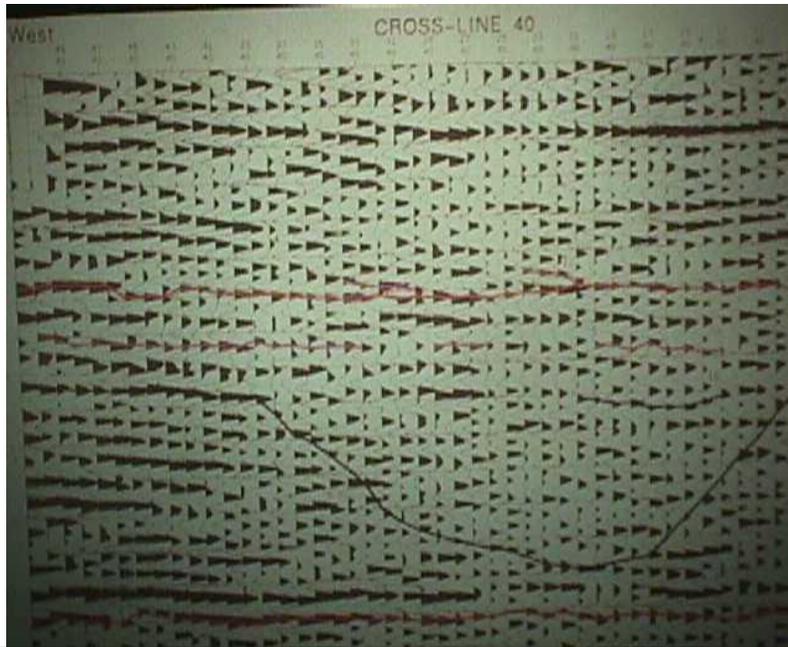


Reflective Seismic Technology

- Reginald Fessenden, Canadian inventor, developed initial techniques to infer geology in 1910s, getting a patent in 1917, but never developed it
- Ludger Mintrop, a German mine surveyor, used seismic technology to find salt domes in Germany in 1910s and also found oil in Texas and Mexico in early 1920s
- John Clarence Karcher in 1910s discovered seismic reflections could be used to detect the location of artillery, and used similar techniques to find oil in Oklahoma in 1921



2D Seismic (showing ancient riverbed)



Improvements in Computers led to 3D Seismic



Old Mainframe Computers

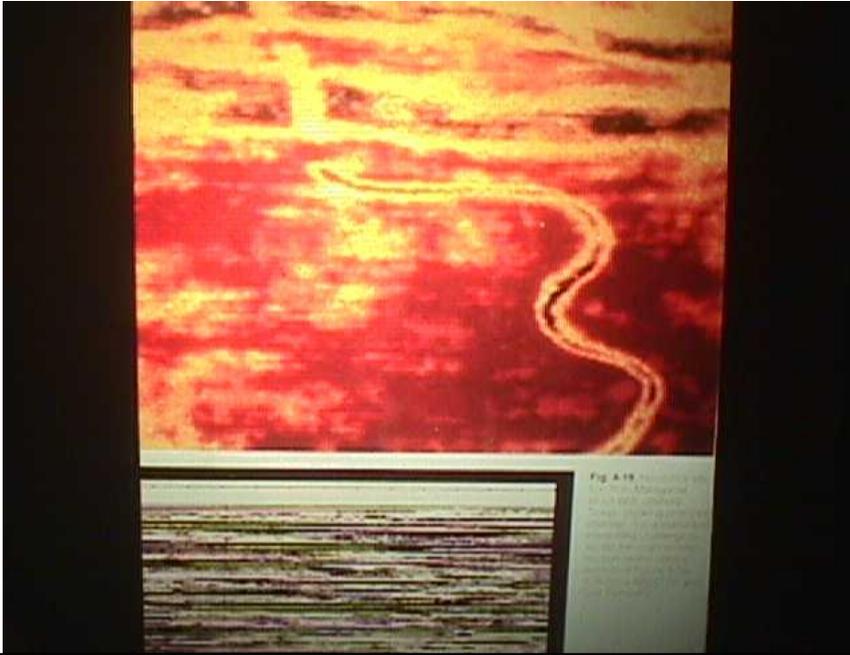


Old Desktop Computer



Modern Laptop

3D Seismic (showing same ancient riverbed)



3D (more detail of same riverbed)



Bombing, Shooting, Acidizing, & Fracing Edward A. L. Roberts, 1864 The Grandfather of “fracing”

- Roberts arrive in Titusville in 1864, after serving in the Union Army
- Inspired by the bombardments at the Battle of Fredericksburg, a major Union defeat, he soon patented a “petroleum torpedo”
 - The Robert’s torpedo was exploded at the bottom of a wellbore, crudely fracturing the reservoir rock in the immediate vicinity of well bottom to increase the flow of crude oil into the well bore

The Roberts Petroleum Torpedo

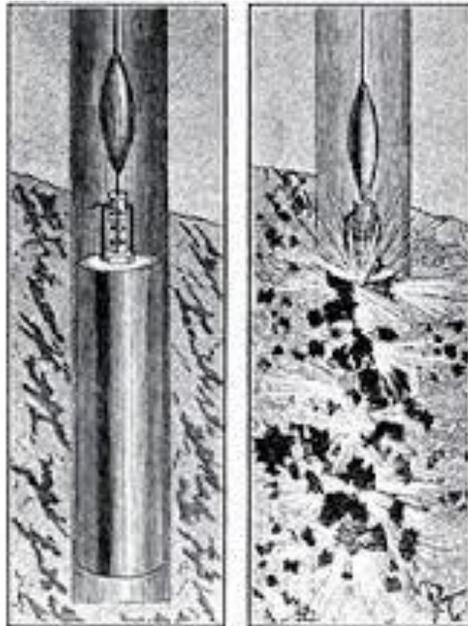


FIG. 134.—The Roberts torpedo, before and during explosion.

Edward E. L. Roberts & Roberts Torpedo Petroleum Company



Nitro Truck

Eventually, gunpowder gave way to “nitro” and led to well-paid but usually short “well shooter” careers!



Nitro Explosion Petrolea, Ontario 1907



1932

- Dow Chemical developed “**acidizing**” wells to dissolve rock to create flow channels for oil in limestone

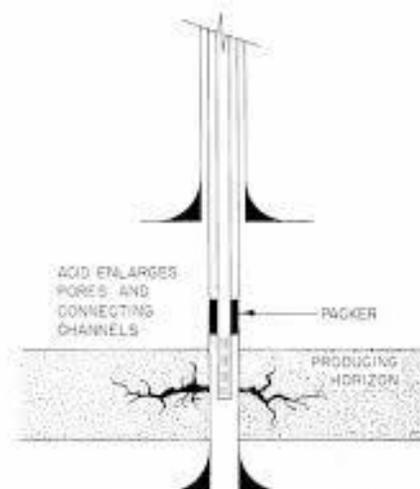


Figure 37. Acidizing operations involve the introduction of acids into the formation crevices to increase the flow capacity of the pay zone. (From *Primer of Oil and Gas Production*, Book 1 of the Vocational Training Series, 3rd ed., API.)

1947

Hydraulic Fracturing

- Riley Farris and Bob Fast hydraulically fracture wells for Stanolind Oil Company in the Hugoton Field in southwest Kansas
 - Patent was filed in 1948, with exclusive license issued to Halliburton
 - More than 100,000 wells were hydraulically fractured by 1955

1959 Nuclear Fracturing!

- 1959: Initial federal research and experiments to test fracturing wells with nuclear “bombs,” first suggested by Edward Teller, father of the hydrogen bomb
- 1967: nuclear bombs set off in gas formation in NM
- 1969: 43 kiloton bomb set off in gas formation (13 kiloton bomb was dropped on Hiroshima)
- Problem: produced gas was radioactive!
- 1973: tried again with DOE funding
 - series of 3 bombs
 - more were scheduled but never detonated—deemed too costly

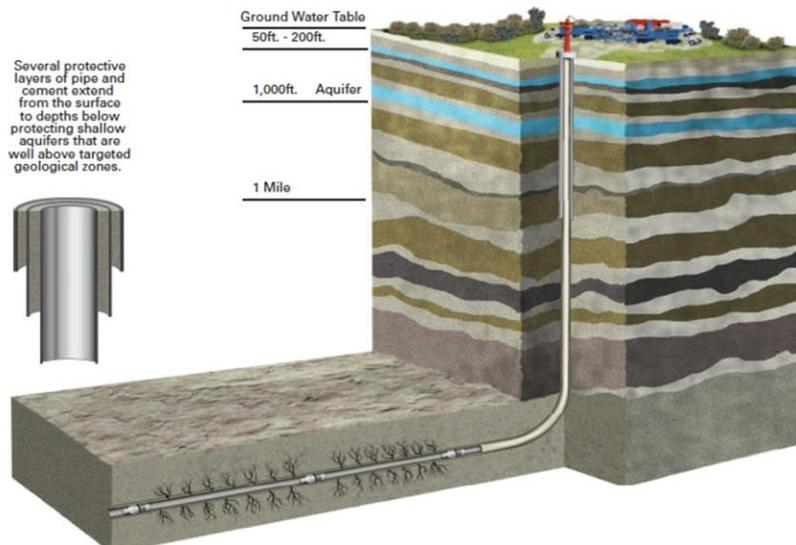


George Mitchell, Mitchell Energy

- In 1982, George Mitchell establishes the Barnett Shale Field in TX, and began experimenting with different hydraulic fracturing techniques
- 1981: Mitchell drilled and hydraulically fractured the C. W. Slay#1 shale well—a well drilled into the source rock or “kitchen”
 - This vertical well was not commercial
- 1998: Mitchell “mistakenly” hydraulically fractures the S. H. Griffin #4 well without using “frac gel”
 - Well succeeds where many others had failed
 - Now, now more than 100,000 such wells drilled and fraced in shales



Hydraulic Fracturing



A Fourth Technology: offshore drilling

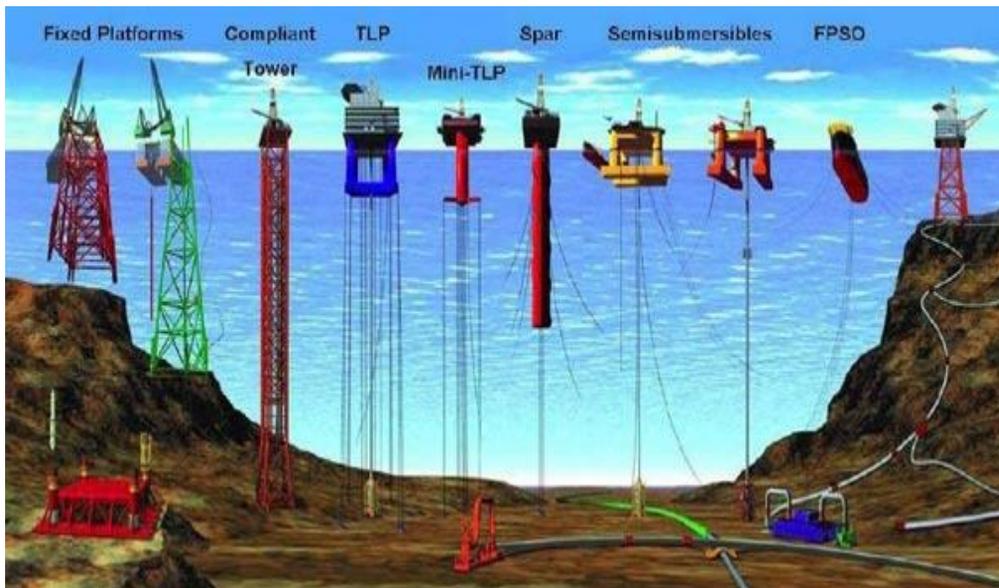
Offshore Drilling from Piers
Near Santa Barbara California, begins in 1896



Kerr McGee drilled first true “offshore” well in 1947



Offshore Drilling Innovations





Other Conservation Challenges

Seismicity

- Some small earthquakes that have caused some damage may have been induced by disposal wells



St. Gregory's Abbey, Shawnee, OK
Damaged by an earthquake in 2011

Water and Hydraulic Fracturing

“Whiskey’s for drinkin’ and water is for fightin’” —Mark Twain

- Wood Mackenzie
 - Agriculture uses 2/3 of global freshwater supplies
 - Energy is second largest user at 15% for all energy uses
 - UN study predicts a 40% shortfall in global freshwater supplies by 2030
 - WoodMac says that water shortages could have a negative impact on shale plays in the US and on Middle East production growth
 - BUT WoodMac is optimistic that new technologies will solve these problems provided regulatory uncertainty does not fetter technological advancement

Unitization of Shales

- Another Wood Mackenzie study, announced September 23, 2014,
 - Preliminary findings: shale production could increase an additional 25% using EOR (Enhanced Oil Recovery) techniques currently being tested in the Eagle Ford
 - Yield could be additional 350,000 – 450,000 b/d
- But WoodMac warns that US will need to allow oil exports to support the additional capital costs of EOR—projected at \$5 billion for each additional 400,000 b/d of production over 5 years
 - Without relaxation of the oil export ban, US oil prices could fall about \$30/barrel under comparable international benchmark crudes

Pre-emption, Peaceful Co-Existence, or Friction: Conservation Law v. Local Law

- Serious problems in Colorado, Pennsylvania, New York, and Ohio
- Yes, even Texas!

Well Locations in Pooled Units

- Oklahoma case law has long allowed the operator of a pooled unit to locate the well anywhere on the unit
 - Including on acreage that was forced pooled in part because the mineral owner also owned the surface and did not want any oil operations conducted on the surface
 - Very controversial in some other states, especially those without recent oil and gas operations and where small-tract acreages are the norm

Why Petroleum Conservation?

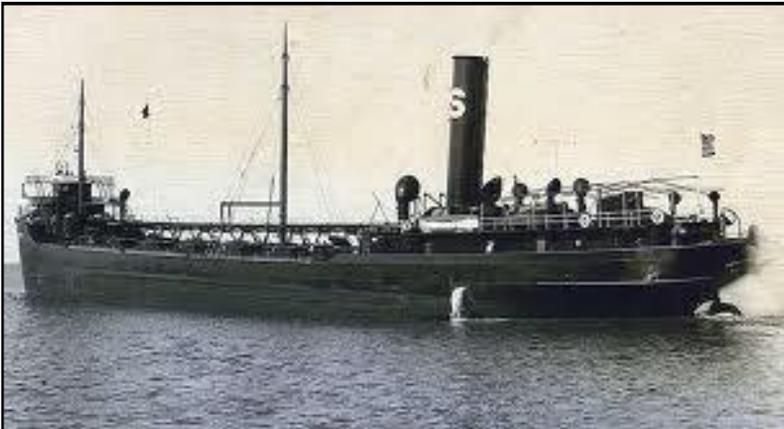


Why Petroleum Conservation?



Why **State** (as opposed to federal)
Conservation Regulation?

Just one example:



In the US, Long-Distance Transport of Oil Is Largely Federally Regulated





Feds have still not approved the Keystone XL Pipeline that should have been approved in 5 years ago

