Oil & Gas In Wyoming

INFORMATION CIRCULAR

OIL AND GAS IN WYOMING

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introduction

Time and again it's been said that America runs on oil. While not totally true, it's close enough. Without oil, automobiles creak to a halt, lights dwindle to darkness, the entire economy falters.

In today's world, oil is as necessary as wood was to our forefathers. We're a nation built on the hydrocarbon molecule.

Wyoming is not exempt from this dependence. Natural gas, a companion product of crude oil production, heats over 94 percent of our homes. Transportation, be it train, plane, bus or car, is powered by oil. Industry depends on petroleum to power their machinery and plants. Fields are irrigated and crops are planted thanks in part to petroleum.

Even more than this, however, oil and gas are the lifeblood of the state's economic health. We produce almost a billion dollars' worth of petroleum annually. Oil and gas account for 41.4 percent of the state's assessed valuation of $2.2 billion and millions of dollars in county and state taxes.

The impact on employment is tremendous. It is estimated that over 10,000 people in Wyoming work in oil and gas related jobs. This does not include such things as oil and gas station operators, mechanics or workers in industries dependent on oil and gas for power.

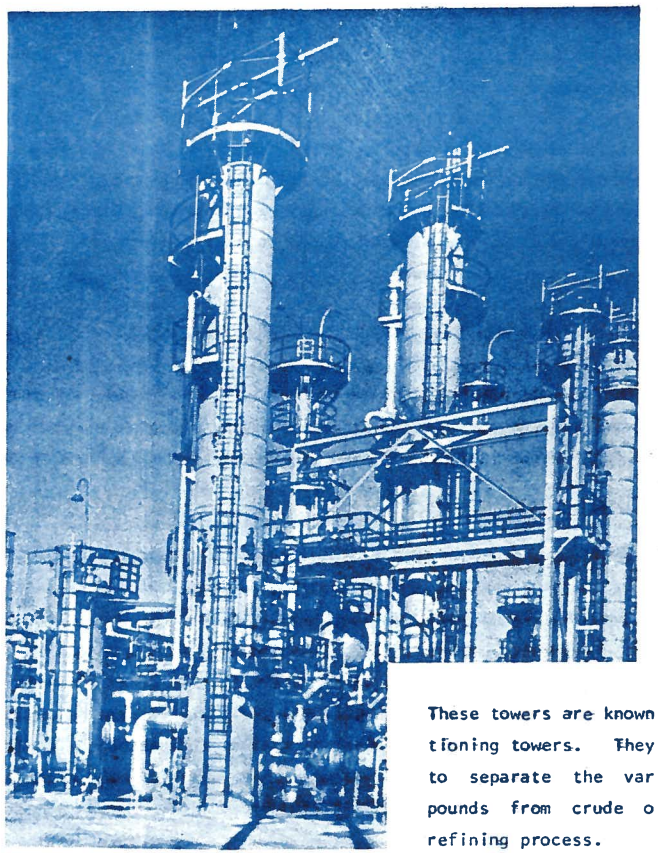
Directly or indirectly, our standard of living, our jobs, our transportation, in many ways our freedom is dependent on oil and gas. It is truly one of the things that keeps America running.

what are they?

Oil and gas are complex hydrocarbons; that is, they are complicated substances made up of carbon and hydrogen atoms. Natural gas is primarily methane, a compound of one carbon atom combined with four hydrogen atoms. It can contain other mixtures of hydrocarbons but its methane base remains the same.

Oil, on the other hand, is a complex mixture of a number of carbon-hydrogen compounds. In a single sample of crude oil, there can be a mixture of substances, from thick gummy asphalt to gasoline to gaseous propane or butane.

Each substance has specific uses but each must be treated to separate it from the crude oil. This separation is usually done by heating



These towers are known as fractioning towers. They are used to separate the various compounds from crude oil in the refining process.

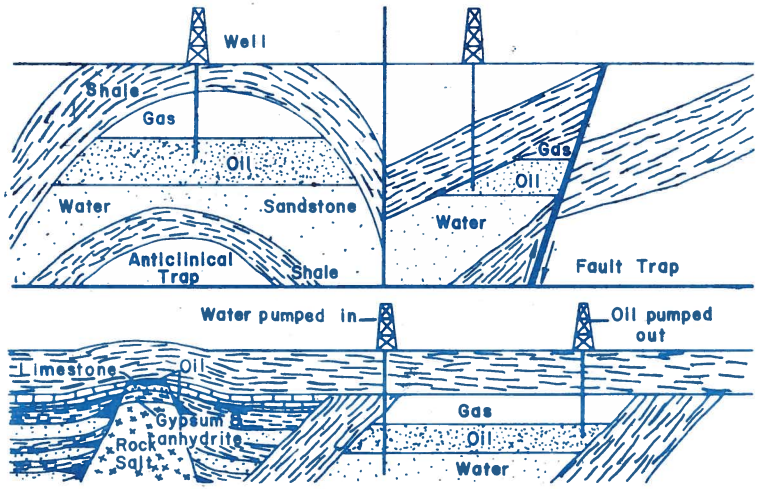
the crude until various compounds are boiled out. Each compound has a different boiling point so by cooling the vapors of a given temperature, various compounds are separated from the mixture. A number of complex chemical treatments are also used in refining. The processes increase the yield of desired compounds, like gasoline.

Both oil and gas contain varying amounts of impurities. These are usually removed in the refining process. One impurity, hydrogen sulfide or sour gas, is valuable in its own right. It is burned to provide a valuable source of the element sulfur.

When people think of the origins of oil and gas a certain picture often flashes to mind. A major oil company's recently televised commercial exploited this scenerio in the common understanding; giant dinosaurs prowling the primeval swamps eventually died, decomposed and were trapped beneath the earth. The dinosaurs eventually emerge in the tank of a passing motorist.

As interesting as this view may be, it is incorrect. Oil and gas come from the remains of tiny one-celled plants and animals that existed millions of years ago. As these creatures died, they drifted to the bottom of ancient seas. There they mixed with sand, clay particles and other debris.

Through millions of years, layers of sand, silt and other material were deposited over the organic remains. Eons passed and more and more



Here, several different geologic traps are illustrated. In each, the principle is the same: oil and gas rise until they are trapped by an impervious layer of rock.

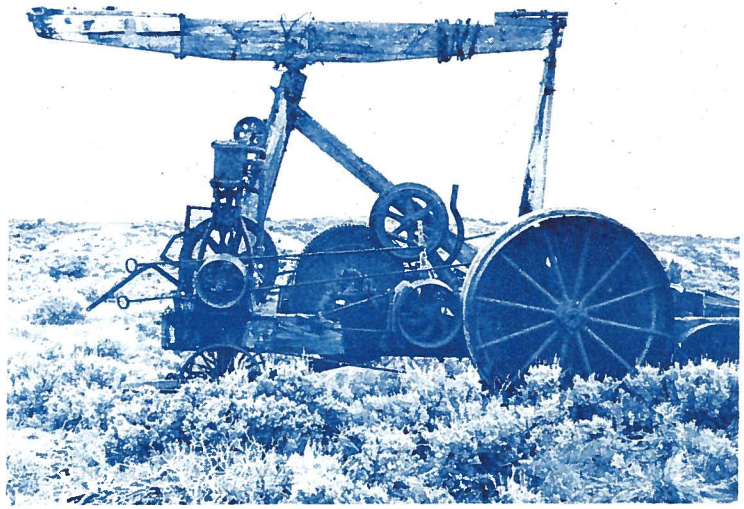
Layers of material built up. These layers created, by their weight, the temperatures and pressures which, combined with bacterial activity, finally formed oil and gas.

If this were the entire story, petroleum would be much more abundant than it is. Another factor is essential to the accumulation of oil and gas: it must, once enough is formed, be trapped beneath the earth.

Petroleum has the ability to flow through a number of rock types. Pressure is exerted in the earth's depths and, if it were not trapped, it would rise to the surface and be lost.

Some rock types are impervious to this flow of oil. This explains why oil and gas tend to collect in fields. Through some fortunate twist of nature, rock layers often combine to produce a sort of underground reservoir, trapping the petroleum and storing it for man. The petroleum rises until it encounters an impervious rock layer, often called "cap rock," creating a reservoir and preventing escape.

Because of differences in weight of gas, oil and salt water, these fluids are separated vertically. Gas is found in the highest part of the trap, oil and oil with gas below the gas, and salt water below the oil.



Oil drilling has not always been a modern technological process. This abandoned drilling rig dates back to around the turn of the century. It is currently gathering rust somewhere in Uinta County.

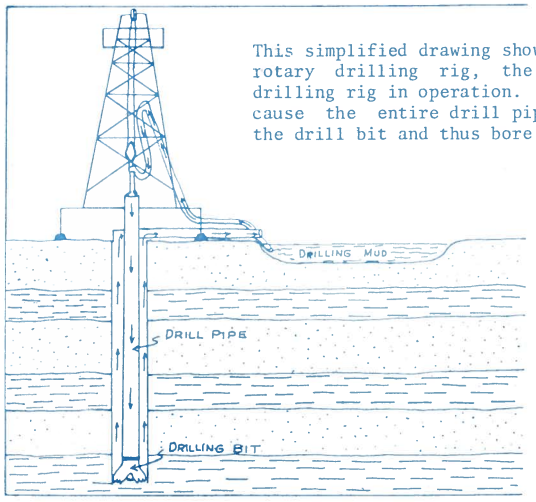
However, oil is not, as some assume, in giant pools beneath the earth. It is interspersed in the tiny pores of sandstone or limestone. An accumulation of a large amount of trapped oil is called a reservoir.

how they are produced

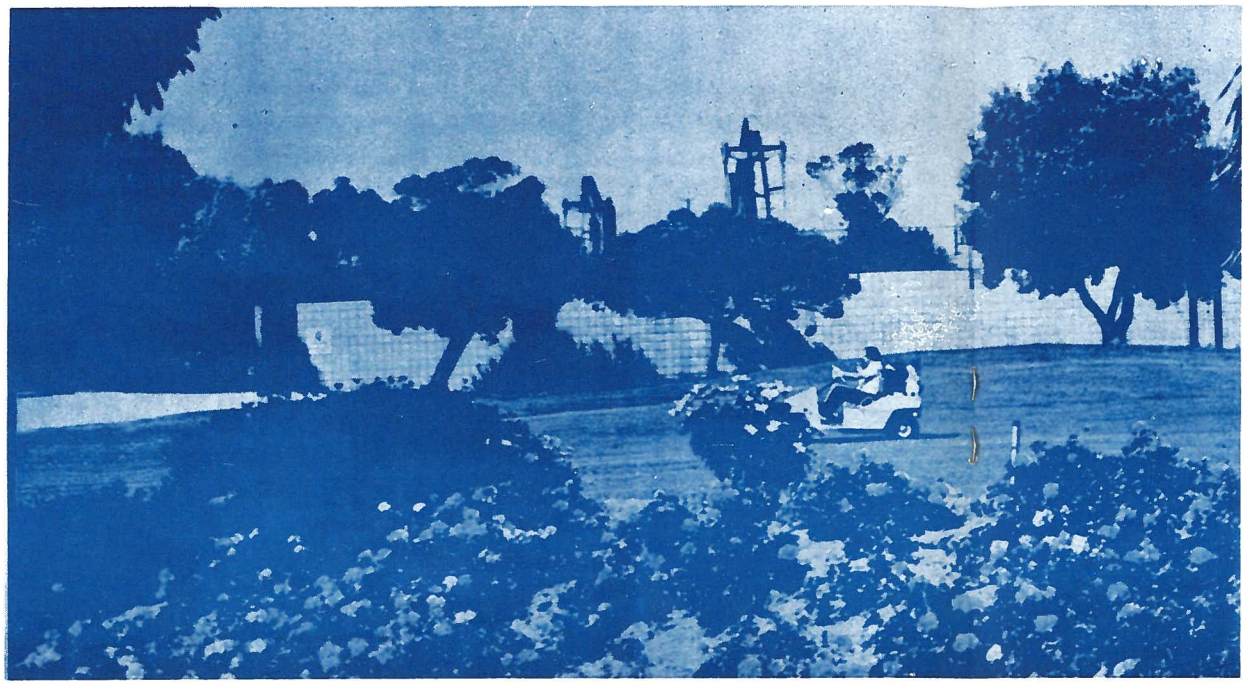
Locating and producing petroleum is a costly, complex process. A great deal of scientific knowledge must be gathered and used to locate likely sites for underground oil reservoirs. Then without any assurance of success, expensive equipment must be employed to drill for the oil. If it's there, a pipeline must be constructed to transport it to a central refinery where it is made into useful products.

In oil and gas exploration, science has called to the forefront some of its most exotic creations. Seismic surveys, gravimetry and magnetometry are all techniques used in the search.

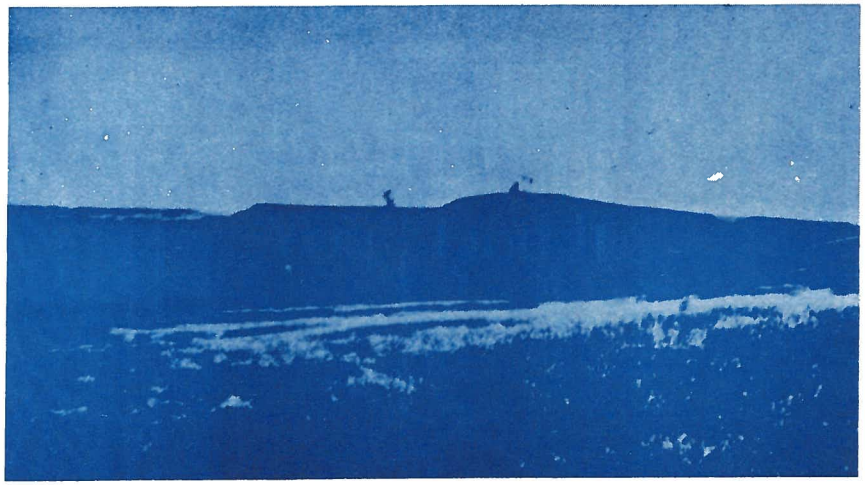
In the most general terms, scientists look for rock types that, based on past experience, usually contain oil. They then examine the configuration of the rock layers or strata beneath the earth's surface. When they find an area with the right rock type where the strata are in the proper configuration, they assume that there might be oil there and recommend drilling and testing.



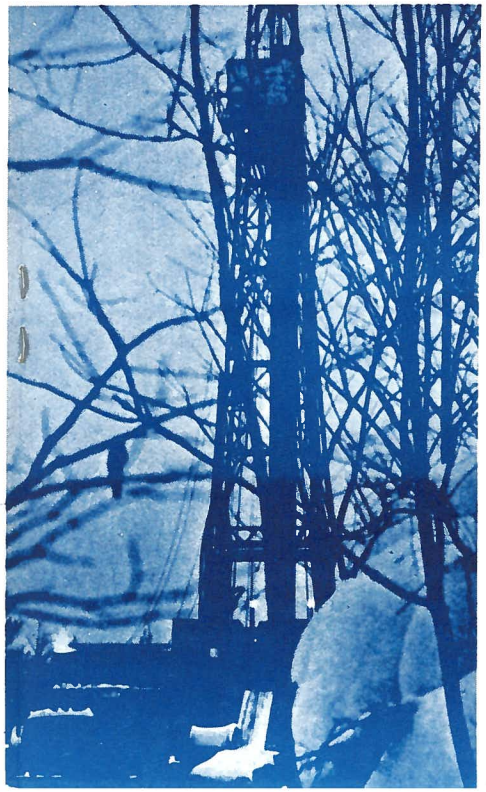
This simplified drawing shows the operation of a rotary drilling rig, the most common type of drilling rig in operation. It gets its name because the entire drill pipe is rotated to turn the drill bit and thus bore deep into the earth.



In downtown Los Angeles (left) or the Gulf of Mexico (below), the search for oil can lead to strange settings. (Photos by MidContinent and Petroleum Today)



The praries of Wyoming (above)and the woods of northern Michigan offer more conventional pictures of the search. (Photos by Amoco)



Petroleum Is Where You Find It

Why all the qualification? Because, for every 25 or 30 exploratory oil wells, only one will recover significant quantities of oil. This adds a gigantic element of risk to the search. When one looks at the prospect of spending over $35 per foot to drill a 5,000-10,000 foot hole without recovering oil, it becomes rapidly apparent that oil exploration is a lot like high-stakes poker.

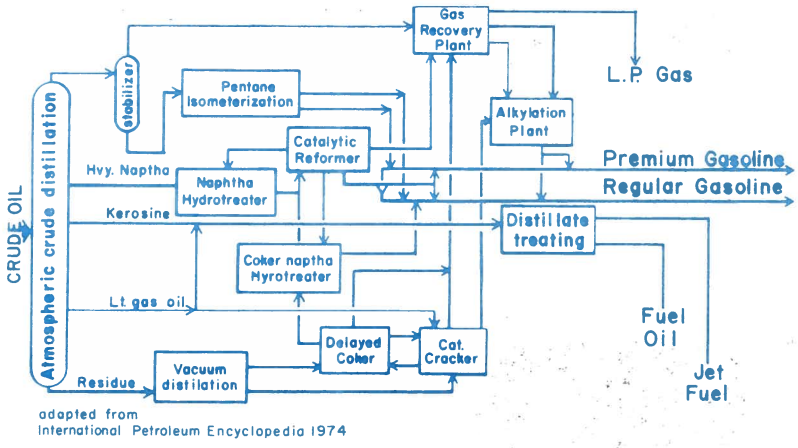
If one is lucky enough to find an oil reservoir, the process has just begun. Most wells produce both natural gas and oil. Both must be handled differently and piped separately to refineries (oil) or processing plants (gas).

It now costs about $50,000 per mile to construct an average pipeline. This figure can climb much higher for unusual installations, such as the Alaskan pipeline. In addition to this, a number of other problems such as right-of-way, environmental concerns and weather can serve to make pipeline construction difficult.

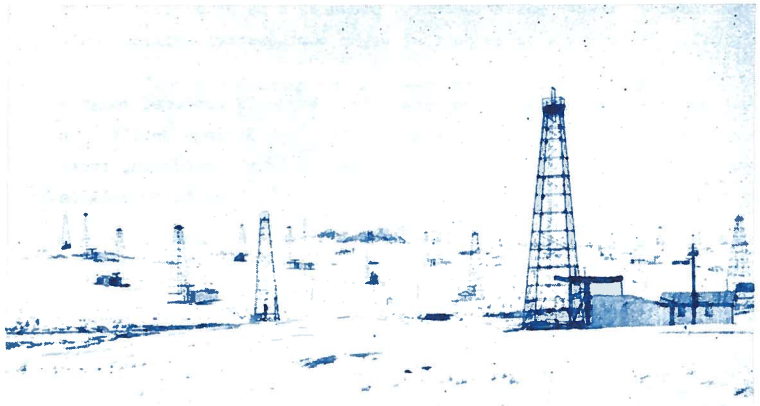
Oil and gas usually travel in separate pipelines and undergo different types of treatment when they reach their destination. The gas is usually cleaned of its impurities and piped to consumers. As noted before, one of the impurities, hydrogen sulfide, is a valuable source of sulfur.

Crude oil refining is a highly involved and interrelated process. The accompanying diagram shows some detail of the process and gives a hint of its complexity. Initially, the oil is distilled. Substances

Typical Refinery



This simplified diagram shows the basic operation of an oil refinery. Depending upon the desired products, other processes may be added or subtracted.



This is an early view of Poison Spider Field, one of the older and more productive oil fields in Wyoming.

with different boiling points are separated and go through a series of additional processes.

Three of these, hydrotreating, catalytic cracking and isomerization, are intended to increase the production of gasoline.

From the initial search to final delivery at the gasoline pump, the production of oil is a complicated and expensive snarl. It requires a high degree of technology, a large capital investment and a good deal of luck. Little wonder then that it is a field where speculation and science make constant bedfellows.

where they are

Wyoming's oil production can be roughly divided into four major regions. The Green River, Powder River, Big Horn and Wind River Basins are the traditional producing areas. In the last year or two, sizable fields (Ryckman Creek and Yellow Creek) have been discovered in another unexpected area, the thrust belt along Wyoming's western border with Utah.

Within each region, the oil tends to come from rocks of approximately the same age. In the Powder River Basin most of the oil is produced from formations of the Cretaceous period. The rocks vary in age from 70 to 135 million years old. In the Big Horn Basin, however, most of the production is from strata of Permian and Pennsylvanian age, over 235 million years old.

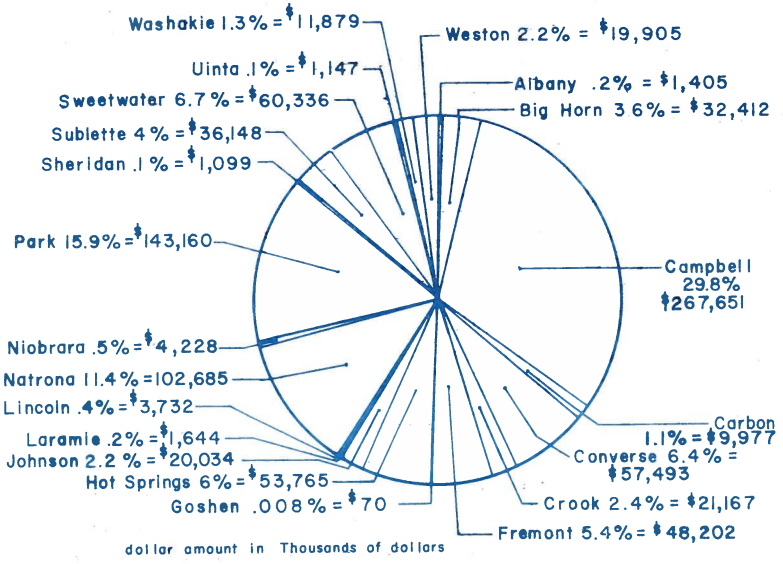
The Powder River Basin currently produces a major portion of the state's oil. It covers a large part of eight northeastern Wyoming counties.

Oil and gas production in the Green River Basin is centered roughly on an arch east of Rock Springs, known as the Rock Springs Uplift, in the south-central portion of the state. The age of the producing rocks ranges from Mississippian up through Tertiary (350 million to 60 million years old).

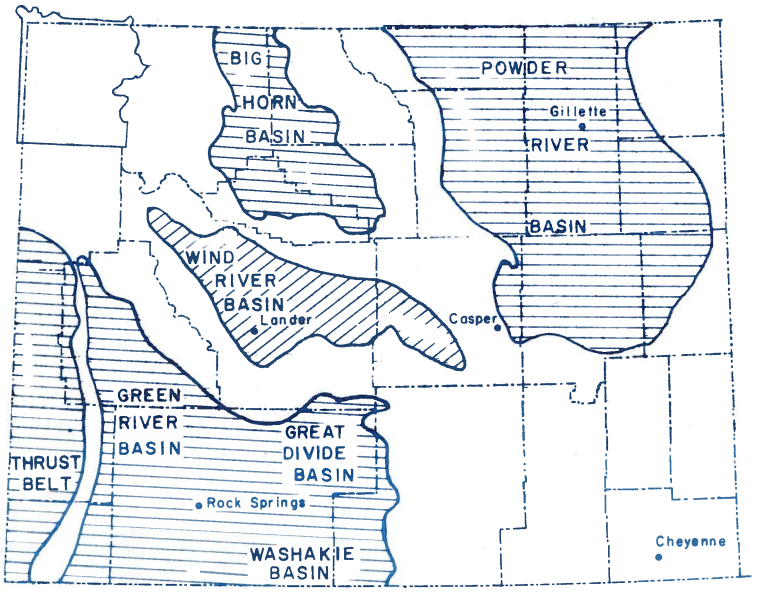
The Big Horn Basin produces petroleum from some of the oldest producing strata in the state, dating over 270 million years. While the region produces some natural gas, the bulk of the Basin's output is in the form of crude oil.

Almost in the center of the state, the Wind River Basin produces much of the state's natural gas. The Basin produces from relatively young (approximately 60 million years old) Tertiary rocks.

The newest of the state's producing regions, the thrust belt area in southwestern Wyoming, has only three producing oil fields (one in Utah and two in far western Wyoming) but it is the scene of some of the busiest exploration in the continental United States. Both of the Wyoming fields produce from Turassic rocks, approximately 135-180 million years old.



As you can see, oil and gas production means a great deal to the counties of Wyoming. This chart shows each county's share of oil and gas generated tax revenue. Dollar amounts are in thousands of dollars.



These basins in the thrust belt region account for the lion's share of Wyoming's oil and gas production.

While the region is not producing much petroleum, it accounts for over 25 percent of the seismic exploration equipment working in the Rocky Mountains. There are 12 oil rigs drilling in the area and 22 additional holes are already planned.

All this activity costs money. Amoco, one of the thrust belt's most active companies, has budgeted over $30 million for thrust belt exploration in 1977. Oil leases in the area can sell for over $1100 an acre.

enhanced recovery

With the nation quickly running out of oil, any additional petroleum is more and more valuable. Only 32 percent of the oil in a given field can be recovered by pumping. A number of factors including the field's geology, its depth, the size of the pores and permeability (ability to transmit fluids) of the reservoir rock, and the viscosity (consistency) of the oil combine to impair total recovery.

In Wyoming, the oil remaining after older fields are lost to primary production totals many millions of barrels. A number of techniques are currently in use and under development to help recover the remaining oil.

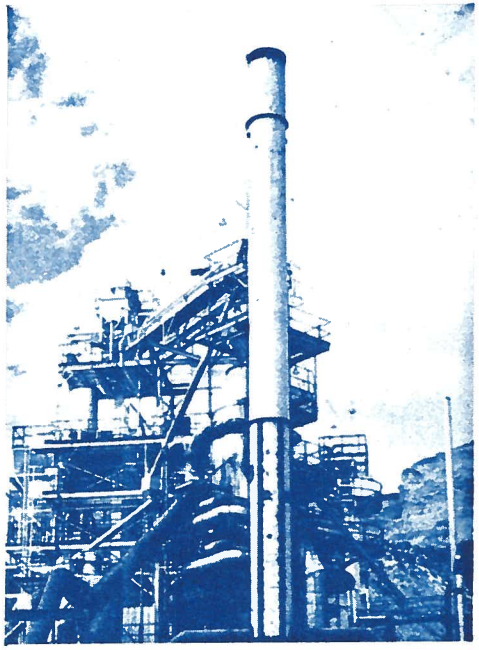
One of the first methods to aid in oil recovery was water flooding. The technique involves pumping water into the rocks beneath or adjacent to the oil reservoir. This tends to increase the underground pressure and force the oil out of the reservoir rock. Natural gas or steam are also used to build up the pressure and force the oil out in older wells.

Occasionally the rocks at the bottom of the well are artificially treated to improve oil recovery. Acid might be added to a formation of carbonate rock, or explosives might be set off to break up the rock immediately around the well's bottom.

Thus far we've discussed only what are known as secondary recovery techniques. When these methods fail, other more technologically sophisticated methods must be used. These methods, known as tertiary techniques, include such things as using detergents to wash the oil from the rocks, solvents to dissolve the oil, or setting an underground fire which, by generating steam, forces the oil from the rock.

Both secondary and tertiary recovery techniques are being used in Wyoming. Secondary techniques are used in almost all areas of the state to both prolong production and bring old fields back into production. Tertiary techniques are less widely used and their cost/return ratios have contributed to their fall from favor.

While the techniques cost additional money, it is money spent in the country as opposed to sending it abroad for imported oil. As the price of oil continues to rise, these methods will become more and more popular.



Oil shale retorts like this one in western Colorado may provide additional oil reserves, but for now, their utilization is many years away.

the future

The petroleum age is, of course, in its decline but it isn't over. Pessimists come to the forefront with dire predictions of a world with an empty gas pump in ten years. Optimists see technology and new finds stretching the time span 50 to 100 years. The truth probably lies somewhere in between.

Although drilling continues to increase (10 to 15 percent projected for 1977), Wyoming's oil production has decreased steadily since the peak in 1970 and 1971. Major fields are running dry, and few if any giant fields remain. The recent thrust belt discoveries and deep exploration in the various basins remain as possibilities to bolster sagging production, and the state's vast deposits of oil shale (a rock type with oil so tightly trapped that special methods must be developed to extract it) will probably become important far in the future.

Whatever may develop, there is a bottom to the barrel. How it will affect Wyoming depends in large part on how we plan for it now.

With the proper foresight and a small amount of luck, Wyoming can retain its position as a leading energy producer by switching emphasis; switching it to coal, uranium, and yes, even wind power.