

the Oil Age

It began 150 years ago this month in Pennsylvania.

Some forecasts say that it has only decades left to go. By Frank Wicks

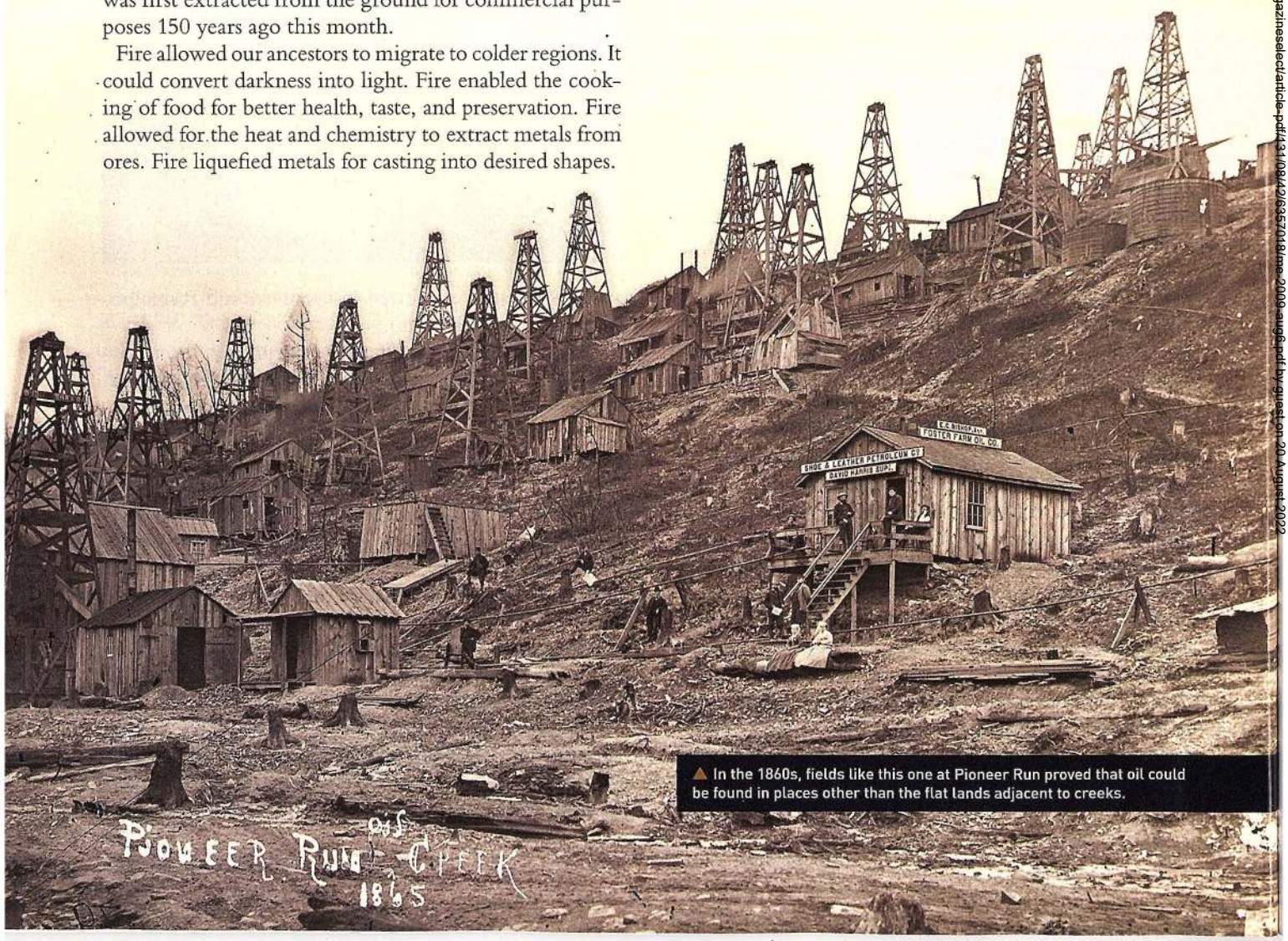
Mythology teaches that fire was the property of Zeus, chief of the Greek gods. It was stolen by Prometheus and given to humans. The truth behind the myth is the titanic importance of fire: It is the basis of civilization. And in today's world, much of the fire comes from petroleum, which was first extracted from the ground for commercial purposes 150 years ago this month.

Fire allowed our ancestors to migrate to colder regions. It could convert darkness into light. Fire enabled the cooking of food for better health, taste, and preservation. Fire allowed for the heat and chemistry to extract metals from ores. Fire liquefied metals for casting into desired shapes.

Fire made engines run, and today it produces most of our electricity.

However, fire is not free. It requires fuel, and throughout the ages much human effort has gone into searching for fuels and processing them into usable forms.

Fire for heating was done mostly by wood and other vegetation. Lighting required more refined fuel and devices.



▲ In the 1860s, fields like this one at Pioneer Run proved that oil could be found in places other than the flat lands adjacent to creeks.

PIONEER RUN CREEK
1865

The Egyptians processed beeswax and papyrus into candles. The Chinese used whale oil for lanterns.

Benjamin Franklin initiated public lighting via liquid fueled lanterns in Philadelphia in 1751. He experimented with combinations of turpentine and alcohol and whale oil.

Applied chemistry of the 1800s was largely devoted toward producing lantern fuel, including coal oil and camphene, a distilled blend of alcohol and turpentine.

Whale oil was prized for best light and low soot, but production peaked in the 1840s. This was the decade when Herman Melville sailed on a whaling ship, which inspired *Moby Dick*. Literary accomplishments aside, civilization needed another source of light.

Seneca Medicine

The modern Oil Age can be traced to a well near Oil Creek in the northwestern Pennsylvania community of Titusville, where an enterprise managed by Edwin Drake discovered petroleum on August 27, 1859. It wasn't the first strike of oil in history, but it was the first that intended to exploit oil commercially as fuel.

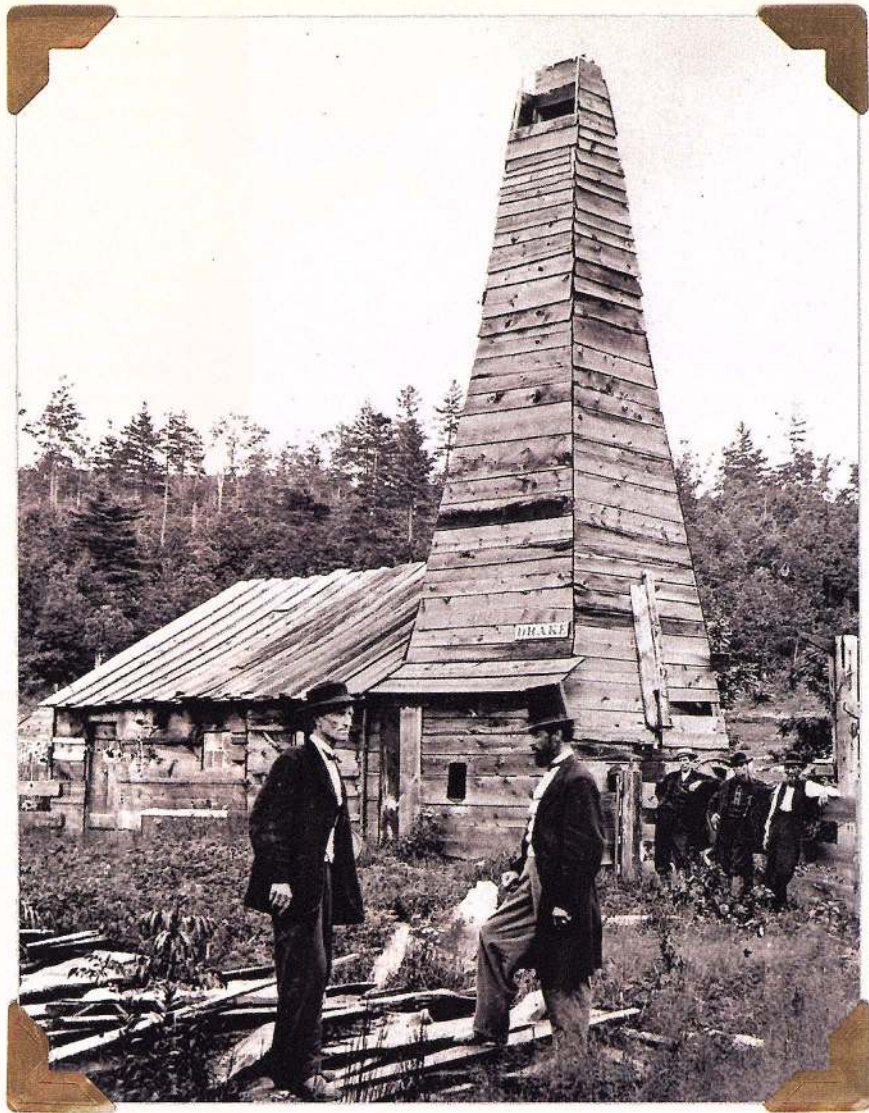
Oil had been found by accident at Petrolia, Ontario, in 1858. Workers digging for water struck a pool of oil at a depth of 14 feet, but that accidental discovery would only be exploited later.

The 1859 Drake well was the triumph of years of speculation, research, investment, and labor that was specifically motivated toward a new and hopefully more abundant lantern fuel. It started in 1851 when an enterprising New York lawyer named George Bissell visited Oil Creek and observed a dark oily substance that bubbled from the creek and contaminated water wells. It had been used by the local Seneca Indians, who claimed it had healing powers.

Bissell realized the crude substance might be processed into a lamp fluid and also as a lubricant for machines. He procured a sample and contracted the analysis to a Yale chemistry professor, Benjamin Silliman Jr. His father, Benjamin Sr., also a Yale professor, was recognized as a leading American scientist and chemist.

Silliman heated the raw material and found different fractions boiled off and then condensed at defined temperatures.

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▲ Colonel Drake, in top hat, in front of the Drake Well No. 1 engine house and derrick, in the summer of 1866. John Mather was the photographer.

All of these products contained carbon and hydrogen.

The product that was named kerosene was tested and found to be an excellent fuel for lighting. A product that vaporized at a much lower temperature—which we now call gasoline—was judged to be too explosive for lanterns. The heavier residual liquid that did not boil had excellent lubricating properties.

These test results were delivered to Bissell in a report dated April 16, 1855. The positive results were a necessary milestone, but an uncertainty lingered. It remained to be seen whether or not a sufficient amount of the raw product could be extracted from the isolated wilderness region around Oil Creek and Titusville.

The required drilling equipment would be expensive and the favorable results were uncertain, but success could produce large fortunes. George Bissell founded the Pennsylvania Rock Oil Co. to raise the venture capital.

Despite his limited means, Silliman became one of the initial investors. A New Haven banker named James Townsend would be a substantial investor, who sustained



▲ Colonel Edwin Drake, a former Great Lakes sailor and railroad worker, became the manager who set off the rush for Black Gold.

the project after the initial less-than-favorable results.

The next vital step was to find the right person for the actual job of obtaining mineral rights and then conducting the search. The improbable choice was a colorful former Great Lakes sailor and railroad worker named Edwin Drake. He also had a railroad pass for free travel. Drake was called “Colonel.” Sources disagree over how he came by the distinction. In 1959, the Pennsylvania Legislature gave Drake a posthumous commission in the state’s National Guard. The text of the act says that Drake was never officially a colonel during his lifetime.

According to a biographer, William Brice, a professor emeritus in the Department of Geology and Planetary Science at the University of Pittsburgh, “As a young man, Drake was a member of the Michigan militia. When he returned to the East after living on the frontier for two years, his friends, no doubt in a kidding manner, began using that title for him.”

Colonel Drake traveled to Titusville and procured leases on surrounding farm land. The initial search was performed by shovel, and it failed. The company would have to search deeper, but doing so would require an increased investment in a steam engine to power a drill.

Colonel Drake hired a local blacksmith named Billy Smith to make the drilling equipment and to erect a derrick next to the engine house to guide the bit. Drake persisted while the investors back in New York and Connecticut were growing discouraged at the slow progress and were preparing to cut off funding.

The Oil Rush

But Colonel Drake prevailed, when petroleum started to seep into the well at a depth of 69 feet. It was ten years after the California Gold Rush started, and oil was dubbed Black Gold. The Drake well created an Oil Rush motivated by the prospect of sudden riches.

The drilling was in a 10-mile valley section of Oil Creek. The creek flows south from Titusville to Oil City and then runs into the Allegheny River, which flows south to Pittsburgh. In 1864 oil was found in Pithole, six miles east of Oil Creek. Within a year Pithole grew to be a city of 15,000 people.

During the Civil War years, the wilderness of northwestern Pennsylvania was initially mostly isolated, except for the lure of oil. A Shakespearean actor named John Wilkes Booth joined the speculators in 1864, at the same time that he was organizing a conspiracy with Confederate sympathizers.

The Civil War was over before the death of Abraham Lincoln, but the Oil Age was just beginning.

While the original intent of Bissell and his associates was to provide a new source of lantern fuel, the unintended consequences now dwarf the original intent. Refineries were originally built to distill kerosene for lamps and to supply some of the viscous residual oil as a lubricant for machinery.

Gaseous products were initially burned as waste, until pipelines were built. They were initially limited in distance and capacity, but were much expanded after World War II.

John Rockefeller made most of his fortune by developing a monopoly on the production, refining, and transportation of kerosene for lighting. He called his company Standard Oil as an assertion of a consistent product that was made safe by the absence of gasoline.

Thomas Edison predicted the end of oil when he invented the light bulb in 1879, and started a central electric generating plant. He was partly correct. It was the first time that practical light could be produced that was not the direct result of a fire. Electricity can be generated from many sources—from falling water to nuclear fission—that use no fire, but most electricity today still relies on combustion, and much of it is petroleum-based natural gas.

Of course, while Edison was developing electric lights and power systems, internal combustion engines were being developed. One version was the spark ignition engine for which previously wasted gasoline would be the best fuel. The other type was a diesel engine that worked best with kerosene.

In later decades the internal combustion engines would include gas turbines for land-based power and for aircraft. Gasoline engines led to the automobile age and the need for paved roads. Eventually smooth and durable blacktop road surfaces would be made with the thickest residual oil from refineries.

Until recently, staying warm during cold weather required spending the summer cutting and drying firewood or having coal delivered, which had to be shoveled into the fur-

nance and would leave ash to be carried out in buckets. It was only after World War II that these winter chores were eliminated by the large-scale introduction of oil, natural gas, and propane fueled heating systems that could also include thermostats for automatic temperature control.

While easy flowing distilled oil was most convenient for home heating, the lower cost residual oil that must be heated to be pumped has fueled ships, and industrial and electric power boilers over the last century.

The petrochemical industry which uses mostly oil and natural gas for feedstock started at the beginning of the 20th century in the form of fertilizers and synthetic plastics and polymers. Today our vehicles have better tires that have resulted from using synthetic polymers rather than natural rubber from trees.

The Boom Moves On

Production in Oil Creek Valley peaked and was mostly depleted over a couple of decades. (Drake's original well had an average yield of 1,000 barrels a day for three years.) Colonel Drake moved to New York where he lost his money as an oil speculator and also lost his health.

Citizens of Titusville traced their own prosperity to Drake's hard work, determination, and resourcefulness. They raised \$4,000 to rescue him and his family from destitution. In 1873 the state of Pennsylvania granted Drake a pension of \$1,500 per year, which was passed on to his wife upon his death in 1880.

The site of the original oil well has been established as the Drake Well Museum and Park. It has a replica of the Drake well with an operating steam engine. Inside displays provide a unique opportunity to learn about virtually all things related to oil.

Tourism is promoted with the slogan "The valley that changed the world." A visitor can take a railroad excursion from Titusville and travel south along Oil Creek. The landscape that was once lined with oil wells has returned to wilderness.

Although oil has been found and extracted at many locations, it should always be recognized to be a finite resource because we can burn it far faster than nature can replace it. In the past, pessimistic forecasts have set near-term dates for the exhaustion of oil reserves and have proved wrong. Optimists always believed bigger reservoirs could be found by drilling deeper, which required penetrating more rock.

At a salt dome formation called Spindletop Hill near Beaumont in east Texas the optimists proved to be correct. Oil was suspected on the basis of seepage of combustible gas from the surface. However, nine years of exploratory drilling had yielded only dry holes until January 10, 1901, at a depth of 1,139 feet—more than 1,000 feet deeper than Drake had to drill.

The resulting gusher blew oil 150 feet into the air at a rate of 100,000 barrels per day. Within a year there were 285 producing wells. Oil production in the United States tripled.

There were very few cars in 1901, and many were electric or steam powered. Spindletop enabled the start of our gasoline-fueled Auto Age. For much of the last century increased amounts of oil have been found at new locations, greater depths, and offshore.

Henry Ford feared that gasoline from oil would not last long enough to sustain a rapidly growing auto industry, and started research for alternatives. The need proved to be premature.

However, the latest estimates based on geological experience and current information are sobering. These estimates match the dire predictions that were formulated in the 1950s by the late Marion King Hubbert, a highly regarded researcher for Shell Oil in Houston. Hubbert documented a consistent time between the year of peak discovery and peak production for oil producing regions.

Most oil producing countries have passed peak production. The United States had been a major exporter until production peaked in 1970. It now relies upon imports for about 60 percent of the 20 million barrels per day that the country consumes.

Another rough estimate is that the world started the Oil Age with about two trillion barrels of recoverable oil. About half of that has been extracted. The remaining trillion barrels represent about a 30-year supply at the current rate of consumption and will be much more difficult to recover.

The fundamental problem is that oil is too good. It is required for most things that we do. The alternatives are mostly inferior or less acceptable. Adapting to the next half and the end of the Oil Age may be the greatest challenge our civilization has ever had to face. ■

The Well Site Today

ASME designated the Drake oil well a Historical Mechanical Engineering Landmark in 1979.

The Drake Well Museum is open seven days a week in Titusville, Pa. Its exhibits include a replica of Colonel Edwin Drake's original engine house and derrick (above).

The museum houses a library of books and materials pertaining to the oil industry. It also maintains a collection of more than 10,000 images, including those that accompany this article.

Information on hours, tours, and the collections is available at the museum's Web site, <http://www.drakewell.org>.

