George Westinghouse

DISCOVERS NATURAL GAS

By William Huber
George Westinghouse is synonymous with Westinghouse Air Brake in Wilmerding, Westinghouse Electric and Manufacturing in East Pittsburgh, Union Switch and Signal in Swissvale, home appliances, and KDKA, but few today associate him with natural gas. In between his invention of the air-brake, and later fighting the Current Wars with Thomas Edison, Westinghouse established a natural gas company that was the predecessor of today’s Equitable Gas Company (now EQT).

Despite ridicule from railroad executives, Westinghouse harnessed compressed air to stop massive trains. That experience led him to control the pressure of natural gas spewing from wells so it could be distributed safely to residential customers and factories. That knowledge, in turn, prepared him to develop ways to increase and reduce the electrical voltage, thus allowing it to be transmitted over great distances economically. So the least-known of his innovations, using natural gas, form the bridge that allowed him to expand far beyond his first railroad invention.

The story of Westinghouse and natural gas starts with Michael and Obediah Haymaker. They had worked as drillers north of Oil City, PA, near where Colonel Edwin L. Drake had drilled the first commercially successful oil well in the United States in 1859.1 The Haymakers sought to duplicate Drake’s feat by drilling for oil on the banks of Turtle Creek in Murrysville, east of Monroeville. They recalled seeing a neighbor, Josh Cooper, boil down maple sap using a gas seep emerging naturally from the creek to start a fire, and the presence of gas often indicated oil. But the brothers had poor-quality drilling equipment, and it took them a year to pound through the 400-foot-thick Pocono Sandstone.

The site of the Haymaker gas well is marked with a plaque and miniature derrick near Route 22 in Murrysville.

All Haymaker photos courtesy of Morgan Downey.

Historical marker commemorating the Haymaker Well in Murrysville.

All Haymaker photos courtesy of Morgan Downey.
Finally, on November 3, 1878, they struck not oil but a high-pressure vein of natural gas. The Haymaker well was the first natural gas well in the Pittsburgh area. Michael Haymaker later described the moment they hit gas:

“I’ll never forget the day the well came in. We were down 1,400 feet. Without the slightest warning, there was a terrific roar and rumble that was heard 15 miles away. Every piece of rigging went sky high, whirling around like so much paper caught in a gust of wind. But, instead of oil, we had struck gas. It was being shot out under such enormous pressure that it continued to shake the ground and roar for months, rattling windows for miles around. You can’t imagine the production at such pressure; we figured the production at 30,000,000 cubic feet/day.”

The brothers had no money, no way to cap the well, and certainly no way to pipe the gas somewhere it might be utilized. For almost three years, that massive vent of gas roared up from the earth. The noisy eruption, nicknamed the “Murrysville Freak,” became a tourist attraction.

The real tourist attraction started on September 18, 1881, when a sightseer’s lantern got too close to the gas and ignited it. Haymaker later remembered,

“One night, a crowd with a few lanterns got too close. I recall a blinding flash. Perhaps there was an explosion. There must have been. My eardrums were ringing. It was a weird moment. Flames it seemed were everywhere. Over all there was one great flare, reaching high into the air. Then my ears cleared and I heard the familiar roar of the well. I picked myself up. All over the ground others were picking themselves up. Some remained motionless. After we took stock, we found that there were no very serious injuries.

Gradually, the flame from the well mouth lowered until it settled to an even 100 feet straight up in the air. The original blast had sent the flame hundreds of feet upward, and it was seen in Pittsburgh, 18 miles away.
It burned for a year and a half, burning thousands of dollars of potential earnings. All the time we were busy trying to extinguish it. That burning well attracted hundreds of people from all over the country. World travelers told me they had never seen a sight so magnificent. It gave us continuous daylight for miles around.4

Murrysville became famous as a place “where there was no night.” Tourists came in droves to view what was said to be “one of the greatest wonders of the day.” Among them were President and Mrs. Grover Cleveland, with the president calling it “an uncanny picture, a superb spectacle.”5

The flames were finally extinguished in March 1883. The Haymaker brothers’ financial backer, looking for additional capital to commercialize the gas, met Joseph Pew and Edward Emerson.6 They incorporated the Keystone Gas Company in 1880, after tapping the Bradford, PA, natural gas field. In 1882, they founded the Penn Fuel Company and bought the Haymaker well and surrounding properties in 1883. Penn Fuel then started to pipe natural gas to Pittsburgh’s East Liberty and Lawrenceville neighborhoods.7

Pew and Emerson went on to form the Peoples Natural Gas Company8 in 1885, Pennsylvania’s first officially chartered natural gas company. They later founded the Sun Oil Company, more commonly known as Sunoco.

Enter George Westinghouse

George Westinghouse read about the formation of the Penn Fuel Company and another story about a factory that converted natural gas as a source of energy and thus saved thousands of dollars in a single year. He recognized the possibilities and broached the subject with his wife.

In the supposed conversation about it, Marguerite replied, “You’d soon get as much absorbed in natural gas as you used to be in brakes when we first married, but the brakes had one advantage over gas—you could always work out your problems at home, instead of running off to Murrysville every day.”

“I can work out my problems at home just the same,” he laughed in response; “that is, if you don’t mind my boring a well through your flower beds. But don’t charge me too much for the privilege. I dare say it will cost me five thousand dollars just to sink the hole and pipe it.”9

Since Marguerite did not object, George got right to work on the grounds of their Point Breeze home, Solitude. On December 29, 1883, he hired the Gillespie Tool Company of Pittsburgh to dig a well, not in the flower beds but near the stable. George and Marguerite, along with their infant son, George Westinghouse III, spent the winter in New York City, far from Pittsburgh’s soot-covered snow. When the family returned in spring 1884, drilling began in earnest. The Gillespie crew constructed a 70-foot-tall wooden derrick to

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hold the heavy machinery. All day long, they operated the noisy power drill, much to the chagrin of a skeptical Marguerite and the neighbors. They knew better than to doubt Westinghouse once he embarked on a quest, but his digging for invisible buried treasure was becoming wearisome. The drilling crew struck two small gas veins, but their yields were meager, and Westinghouse urged them to continue digging.

Finally, on May 21, 1884, the foreman reported more signs of gas. When George asked the current depth of the well, the foreman replied, “About 1,560 feet.” “Are the signs of gas strong?” “No, sir, weak; but I’m perfectly sure that a good supply is there, or not far away.”

Westinghouse concluded, “The only way to find out is to go on. Perhaps by tomorrow we shall get results that amount to something. Only, go slow—feel your way along. Be very careful of the men, and warn them to take no risks.”

George slept soundly that night until he was jolted awake before sunrise by a thunderous explosion. And there was a continuous roaring noise, or had his hearing been damaged by the blast? He dressed quickly and went outside. What had been an organized construction site was now complete chaos. Gravel, sand, mud, and dirty water covered his usually well-kept lawn. The drilling derrick had been decapitated, and the engine was thrown several yards away, landing under the debris. A geyser of mud spewed from the well, along with a hurricane-like roar.

Eventually, workers emerged from behind trees, and rattled neighbors and strangers cautiously approached. What had happened?
After carefully extending the well just 15 feet deeper than the previous day, the workers had heard hissing and rumbling sounds issuing from the hole. They dropped everything and ran for their lives as a great roar pursued them.

Marguerite retained her usual good humor when George asked, “Are you satisfied with the experiment?” She replied, “Oh, very well. The house still has a roof on it, and the kitchen isn’t wrecked.”

A New Toy
Westinghouse and his like-minded friends played with the roaring stream of gas, estimated to flow at about 20 million cubic feet per day, attempting to stop or divert it with large rocks and heavy planks. Whatever they placed in the flow was immediately thrown high in the air or splintered. Then they used the derrick to hold a 100-pound stone on a rope over the opening. As they lowered the rope with its attached stone over the well, the flow shook the stone loose and lifted the line straight up in the air. The roar of the escaping gas continued day and night for almost a week until Westinghouse devised a sturdy stopcock to shut off the flow. Peace and tranquility returned to the neighborhood, at least for a few days.

He then got the idea to see if the gas would burn. He constructed a 60-foot-high pipe above the mouth of the well with a pulley and wire rope attached to the top. On a fateful evening (as Westinghouse thought any flames would be more impressive at night), he tied oil-soaked rags to one end of the wire rope and turned on the stopcock restraining the gas. George ignited the rags and slowly pulled the other end of the wire rope to hoist the burning rags to the top of the pole where the gas was escaping. A faint bluish flame surrounded the end of the pipe. Then, WHOOSH!

Suddenly, a 100-foot high pillar of fire emerged from the top of the pipe. Of course, the roar of the escaping gas returned to add another sensation to the display. The color of the flame varied from a sky blue cone at its base; a pale yellow at its middle; then a dazzling white; and finally, shades of yellow, orange, and red at the top. People a mile away could read the fine print of a newspaper by the light of the gigantic gas flare.

The novelty of perpetual daylight combined with the constant roaring noise wore off quickly. After less than a week, the evening performances ceased, and George announced that he would connect his gas well to a distribution system to supply light, heat, and industrial fuel to the area.

Westinghouse dug three more gas wells at Solitude and four other wells in Point Breeze.
and Homewood.\textsuperscript{14} Solitude became one of the first homes in the city to be lighted and heated by natural gas.

Some authors claim that Westinghouse provided gas to his neighbors, Henry Clay Frick and H.J. Heinz, but there is no documentation to support that claim.\textsuperscript{15} For Frick, archival records indicate that gas service to his estate, Clayton, began in 1883 and that the East End Gas Company supplied gas via lines laid by Ernst Axtlem.\textsuperscript{16} As gas was not discovered at Solitude until May 1884, Clayton’s gas most likely came from wells in Murrysville. Heinz moved into his estate, Greenlawn, on April 6, 1892, long after Westinghouse ended his involvement in natural gas ventures.\textsuperscript{17}

**Commercialization**

Westinghouse’s knowledge and experience dealing with compressed air for train braking gave him an advantage in establishing a natural gas distribution system. But natural gas has properties that air does not. Both are colorless and odorless, but natural gas is flammable and potentially explosive.\textsuperscript{18} Furthermore, gas from a well is at whatever pressure nature determines, and that pressure can fluctuate without notice.

Two natural gas companies, including Pew and Emerson’s Penn Fuel Company, had been serving the Pittsburgh area since late 1882, long enough to identify the hazards of the fuel. Poor design and execution resulted in uneven gas pressure, and sometimes the gas flame went out. If the gas supply was not turned off, as it often was not (the gas was almost odorless, so gave no warning of its accumulation), any spark or flame could cause an explosion.\textsuperscript{19} Also, gas leaking from the distribution piping would often seep into buildings, build to an explosive concentration, and blow up. Insurance companies warned of exorbitant rate increases if changes were not made to create safer distribution systems.
Quick to see the business potential, Westinghouse purchased land in the Murrysville area where there were proven gas wells and leased some of those wells. Westinghouse located a dormant charter for The Philadelphia Company, which had been established by Thomas Scott of the Pennsylvania Railroad for railroad lines but could be used for any utility. Westinghouse bought the charter for $35,000 and incorporated the new Philadelphia Company on August 4, 1884. He also aggressively pursued industrial and domestic gas customers and purchased competing firms. By the beginning of 1885, five firms, including Westinghouse’s Philadelphia Company, were drilling gas wells in and around Pittsburgh.21

Westinghouse recognized and understood the hazards of natural gas and developed a distribution system to avoid them. His first safety-oriented approach was to use double-piping to convey the gas. The smaller-diameter pipe from the well was enclosed within a larger pipe. Gas leaking from the smaller, pressurized pipe was collected inside the larger pipe and released at safe locations, such as gas street lamps, where it was safely burned off. Later, he used a similar but cheaper approach, encasing each joint of the supply pipe in an air-tight enclosure, thus safely trapping any gas leaking from the supply pipe.

Because gas pressure from the well was often high and variable, Westinghouse used a graded-diameter pipe to send the gas to its usage points. Starting at the well, he used an eight-inch diameter line. After four to five
miles, the diameter was stepped up to 10 inches, then 12, 20, 24, and 30 inches. Later, a 36-inch pipe was used. For a given amount of gas, increased pipe diameter results in decreased pressure. By the time the gas reached its user, standard regulators easily controlled the reduced pressure.

To enhance his competitive position, Westinghouse encouraged his Pittsburgh City Council allies to introduce an ordinance requiring the use of Westinghouse-patented inventions, including double-piping of gas lines in the city. The Pittsburgh Post-Gazette warned that "the extension of weak and imperfect pipes through the city" meant that its citizens were "living on a powder magazine" and demanded that the "Westinghouse Ordinance" be passed. City Council passed the "Westinghouse Ordinance" on July 31, 1884. Encouraged by Westinghouse’s offer of free gas for the city’s firehouses, police stations, markets department, and city property department, Council on November 13, 1884, approved a franchise for the Philadelphia Company to operate within Pittsburgh.

But gas explosions continued, resulting in injuries, deaths, and destruction of property. An editorial in the February 2, 1885, Pittsburgh Post-Gazette titled, “Death in the Streets,” stated, “Save in a state of war we don’t believe any large city in the world was ever in a more perilous situation than Pittsburgh is today owing to the dangers of natural gas explosions.”

The city council appointed a Natural Gas Commission and, by August 1885, passed an act setting standards for installing and testing pipe under the direction of the city engineer. Again, the act specified several Westinghouse-patented improvements in gas transmission.

One development, in particular, addressed the problem of “flame-out,” wherein the flame goes out because of a temporary drop in gas
pressure. To prevent explosions from accumulated unburned natural gas, Westinghouse invented the automatic cut-off regulator. If the gas pressure dropped below the required working pressure of four ounces per square inch, the regulator turned off the flow of gas from the street. Only when all gas appliances served by the line were turned off could the regulator be reset, resuming gas flow.

Westinghouse also invented a gas meter so customers could be charged for their actual usage instead of paying a flat monthly fee, as had been the practice. In 1888, the Philadelphia Company installed Westinghouse’s meters on all of its natural gas services, thus saving about 60 percent of gas usage. Westinghouse eventually received 38 patents related to natural gas.

Jurisdictional disputes between the city of Pittsburgh and the Commonwealth of Pennsylvania disrupted the regulation of the gas industry, but by 1886, six companies with 107 gas wells were piping gas into Pittsburgh for industrial and residential use. The largest of these was Westinghouse’s Philadelphia Company, which had bought out 20 smaller firms, including the Penn Fuel Company. In 1886, the Philadelphia Company had 58 wells and 184 miles of distribution piping in Pittsburgh, three times as much pipe as the other five gas companies combined. Just two years after its incorporation, the Philadelphia Company was the world’s largest natural gas supplier.

Growth continued in 1887 when the Philadelphia Company expanded to 494 miles of pipe, serving more than 12,000 private homes and 582 industrial customers. Natural gas displaced an equivalent of 12,000 tons of smoke-producing coal daily. In 1888, the Philadelphia Company formed a wholly-owned subsidiary, the Equitable Gas Company—by 1911, Equitable controlled 1,000 oil and natural gas wells, had leases on
more than 440,000 acres, owned 3,000 miles of
pipelines, and served 110,000 customers. Westinghouse resigned as president of the
Philadelphia Company in 1889 but remained
on the board of directors.

Impact of Natural Gas on Pittsburgh

Pittsburgh has a long history of pollution and struggles to alleviate it, even to this day.
Fracking has renewed the focus on natural gas in Western Pennsylvania, with plentiful
supplies balanced against falling prices and environmental damage. Historically, extractive
industries such as coal mining led to some of the
most significant and longest-lasting impacts on the
environment. The 1762 discovery of a coal seam along
the south bank of the Monongahela River resulted in
carbon becoming the dominant
energy source that fueled the
industrialization of most of the
country, but Pittsburgh's environment paid the price.
Smoke pollution was the most noticeable effect of coal
consumption and gave the city
its identity as the "Smoky City." An 1816 visitor described the
scene, "Pittsburgh was hidden
from our view until we descended through the hills
within half a mile of the Allegany [sic] River.
Dark, dense smoke was rising from many parts,
and a hovering cloud of this vapor, obscuring
the prospect, rendered it singularly gloomy.

The discovery and commercialization of
clean-burning natural gas provided a respite,
however brief, from the pollution. By 1886,
estimates of the amount of coal displaced by
natural gas ranged from 6 to 20 million tons
per year. Of course, the downside was soaring
unemployment in the minefields.

National publications noted the benefits of
natural gas and the dramatic reduction of
pollution in Pittsburgh. In February 1892,
Harper's Weekly observed, "A peaceful
revolution took place in Pittsburgh. The great
mills ceased to belch forth huge clouds of
smoke, the merchant no longer looked upon
soot as the chief enemy of the human race, and
the careful housewife put gas burners into her
cocls stoves and took courage to clean house." As a result, Pittsburgh lost its "Smoky City"
title, at least for a time.

Wistful thinking abounded, as local
leaders proclaimed the "almost incomprehensible quantities" and
"inexhaustible" nature of natural gas supplies.
But as early as 1890, fluctuating and dwindling
natural gas supplies were already affecting
industrial users.

By 1891, Andrew Carnegie's Edgar
Thomson Steel Works became disillusioned
with the availability and cost of natural gas and
switched back to coke for fuel. George
Winghouse countered by suing Carnegie for
a rather large unpaid gas bill amounting to
$580,000. The lawsuit was ironic because
Carnegie had been instrumental in "securing
for Westinghouse a practical monopoly of the
natural gas business here" in Pittsburgh. Also,
Carnegie's partner, Henry Clay Frick, had been
director in Westinghouse's Philadelphia
Company. There is no public record of how
the millionaires settled their dispute.

In 1892, William Metcalf told the
Engineers' Society of Western Pennsylvania,
"We are going back into the smoke. We had
during years of wonderful cleanliness for
Pittsburgh, and we have all had a taste of
knowing what it is to be clean. We all felt better,
we all looked better, we all were better. But we
are back into the smoke. It is growing worse
every day."

Metcalf was an optimist. Natural gas
consumers, both residential and industrial,
continued to increase while local gas supplies
decayed. Gas had to be piped, with the aid of
compressor stations, from West Virginia wells. The
smoke was back, as described in Meda Logan's
"Ode to Pittsburgh, which captures the public's
conflicted view of the heavily polluted city.

The smoke and soot remained until after
World War II. In 1946, democrat David L.
Lawrence was elected mayor on a platform of
cleaning up the city. Lawrence's unlikely
alliance with wealthy republican banker,
Richard King Mellon, led to the bipartisan
Pittsburgh Renaissance.

George Westinghouse's work with
compressed air to activate railroad air brakes
taught him how to handle compressed gases.
Hoses or pipes must be used to carry such
gasses, and those conveyances leak. The
flammability and explosive potential of natural
gas added more constraints to the distribution
system, as did the need to measure the quantity
of gas dispensed.

In some ways, electricity is like natural
gas. Both are sources of energy, both have to
be transported to their users (natural gas by
pipes, electricity by wires), both must be
metered to recover costs and make a profit,
and both can be dangerous or even deadly if
improperly used.

The knowledge that Westinghouse gained
from his flirtation with natural gas helped him
develop a practical transmission method for
electricity and led to its pervasive nature in our
lives today.

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This article is adapted and expanded from his
recently published book, George Westinghouse:
Powering the World.
An infamous and tragic gas explosion occurred on Pittsburgh's North Side on November 14, 1927. Twenty-six people died when workmen from Equitable Gas—13 in all, some with acetylene torches—were repairing a leak on top of a massive natural gas storage tank, which had a capacity of 5 million cubic feet. When that tank exploded, it ignited a 4-million-cubic-foot-capacity tank just 200 feet away, then a third tank, this one 500,000 cubic feet; also went up. It was a triple explosion of mammoth, deadly proportions. Video of the spectacular explosion is at https://www.youtube.com/watch?v=1YWVP8w-a8w.

An extraterrestrial visited Earth in the 1982 movie, known to locals as “ET,” a name applied long before the extraterrestrial visited Earth in the 1982 movie.

Carnegie named his massive steel plant for his largest customer, Edgar Thomson, President of the Pennsylvania Railroad. The Edgar Thomson Works is known to locals as “ET,” a name applied long before the extraterrestrial visited Earth in the 1982 movie.