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Tech Talk - the development of a natural gas market and the GGFRP

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Recently the New York Times had a short series dealing with corporate and governmental e-mails on the natural gas found in shale in the United States, with some question as to the immediate value of those resources. I commented on the reports at the time, but it is perhaps timely as I review oil deposits in the United States to also comment a little on natural gas, since it is in part the availability of conventional natural gas, as well as imported liquefied natural gas (LNG) that together hold down the gas selling price, and in the United States, make it more difficult for the more expensive shale gas to find a profitable place in the market.

The power that can be released by burning natural gas has been known since 1777 when Alessandro Volta (he of the "volt") used a glass "spark" pistol to ignite a mixture of marsh gas and air, and propel the sealing cork out some distance. By that time it had been several thousand years since the Chinese first piped gas through bamboo pipes to boil seawater. Following the more modern pathway, it was in 1792 that William Murdock (Murdoch ?) first used gas to light his cottage, though he "manufactured" it from coal, and it was initially this coal gas which was used to light homes, factories (1804), and in street lighting (London 1807).

When first used in 1816 in the United States, in Baltimore, the gas was produced from a gas works (where coal is heated and the resulting gas – mainly hydrogen and carbon monoxide – is collected, cooled, cleaned, and distributed). Much of the initial development of the industry (see for example, that of the Atlanta Gas Light Company) was built around generation of this coal gas. It was not until 1825 that the first commercial natural gas well was sunk in the United States, although an accidental well had been drilled (and caught fire) in 1815. That first well produced gas used for local lighting.

> By August of 1825, two stores, (one a grocery store) two shops, and one mill (the property where the well was drilled) in the village of Fredonia were being lit by natural gas produced by the Hart well. The gas was brought to these buildings by use of small wooden pump-logs with tar-laden cloth over their joints for a distance of several rods. However, due to the permeability of these pipes, they were soon to be replaced by lead and tin piping. What impressed people the most was the lit gas did not emit an odor.

The first natural gas company in the United States was apparently the Fredonia Gas Light and Water Works Company of New York, founded in 1857, and renamed the Fredonia Natural Gas Co in 1858. For those who think that fracturing a well to improve fluid flow is a recent discovery, some of the earliest wells in Fredonia (December 1857) were artificially fractured to improve gas flow. The technique was, however, perhaps a little primitive:

> "In Risley seed garden, adjoining the creek, a boring has been made by laborious drilling in the solid rock, four inches in diameter, and to the depth of 122 feet. No gas having made its appearance at this depth, the experiment was tried of blowing out the crevices

> of the rock with gunpowder. A canister of 8 pounds was accordingly sunk to the bottom of the boring, connected with the surface by a hollow tin tube. Through this a red hot iron was dropped, and the explosion which expelled the water in the shaft, was followed by a plentiful supply of gas."

Interestingly the price for the gas was $4 per thousand cubic feet (kcf), which meant that the local town paid $16 per year per street light which illuminated most street corners and businesses by June 1859.

The first commercial heating application mimicked that of the earlier Chinese application in that it was used by William Tomkins to evaporate salt brine in the Upper Kanawha Valley of West Virginia, in 1841. However the temperature produced was not that high, and it was not until 1860 that Robert Bunsen created the variable air/gas mixing burner familiar to those of us who used it in chemistry class. This ability to create a much higher temperature (which Bunsen needed for his work on spectroscopy) showed that natural gas could be an economic fuel. However, because it is used in greater relative volumes than the competing fuels coal and oil, and storage was not that simple, it was not until the growth of natural gas pipelines following World War II that the industry began to grow significantly; although, during the Gaslight Era, natural gas was, until the 20th Century, the dominant method of creating artificial light. But while this market was of some significance, it was largely a local industry and did not provide enough market to use the quantities of gas that were becoming available from other sources.

Because of the lack of methods of collection, distribution, and delivery to an adequate market, much of the early natural gas production that came about with the mining of coal or the extraction of oil was considered more of a nuisance than a financial benefit. Without an efficient pipeline network, the gas found in coal mines was diluted to safe levels and released to the atmosphere. In oil wells it was, and often still is, flared at the well head. For example, at a well in North Dakota this year.

Flaring gas at an oil well in North Dakota (Glenda Baker Embry)

In many countries gas flaring is still widely practiced as the predominant method of disposing of the natural gas that comes out of an oilwell with the oil. Because of this, in 2002, the World Bank started a Global Gas Flaring Reduction Partnership (GGFRP) to capture the value of the otherwise wasted resource. As an example of the scale of the wasted resource consider that in

2009 Indonesia flared 3.7 billion cubic meters (bcm) of gas (0.98 Tcf), worth about $450 million, but now plans to eliminate all but "necessary" flaring by 2025. Saudi Arabia flared 38 bcm in the 1980's, but by 2004 had reduced this to 120 million cubic meters. The GGFRP estimates that some 150 bcm (5.3 Tcf) was flared globally in 2006, 30 bcm (about 1 Tcf) in Russia alone. The World Bank hopes that, through the GGFRP much of this will, in future years, be captured and marketed.

This growth of supply requires largely only the provision of a network for collection and distribution, since the gas is produced as a byproduct from the oil that the wells were sunk to find. Thus, as this comes into the world market, it will provide additional volumes in the near future that will provide continued competition against that produced from the shales of the world, but at a lower price.

Similarly the costs for production of natural gas from the more permeable rocks of conventional reservoirs will remain below that produced from shales, and so I will continue this series for the next week or so by taking a look or two at conventional gas reserve development in the United States since the Second World War.