DEEP DRILLING THE ORISKANY IN CENTRAL PENNSYLVANIA

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The central Pennsylvania gas fields found in the Oriskany sand in Clinton and Clearfield Counties have been a big part of Pennsylvania gas production since 1950. A number of sources have covered the geology and reservoir characteristics as well as the historic aspects of the Leidy field of Clinton County. Less well known is the Clearfield County area known as the Driftwood Punxsutawney field which came into prominence in the middle 1950s. Most of the gas producing areas have now been converted to gas storage fields and are no longer producing virgin natural gas.

Several publications of the Pennsylvania Geologic Survey have covered geology features, but seldom mention how these fields were developed and the drilling problems involved. This paper will attempt to clarify the drilling and production aspects that I experienced as I lived and worked in the Clearfield County end of the main field. Much of the information presented is from my own personal experience. Any specific data presented is from personal knowledge of fifty-plus years ago. Because of the interrelated connection between Leidy and Clearfield County fields I also gained information on the Leidy area through contact with those who *made the boom* in that area. The current Marcellus *boom* in Pennsylvania is about the fifth boom I have experienced (enjoyed?). While the gas and oil technology has changed over the years it is still lots of mud, bad weather, and hard work.

By 1950 most of the Pennsylvania Oil and Gas Fields were mature and facing decline. However, in that year a wildcatter named Dorcie Calhoun [Aquila Dorcie Calhoun (1905 – 1975)] electrified the gas drilling industry with his discovery well at Leidy in Clinton County. This large producer was the result of faith in the belief of gas under his farm. To accomplish this, Dorcie brought, from Bradford, an old shallow-well drilling machine to the farm. By sheer force of will, and his inventive genius for repairing the rig, he drilled to over 5600 feet with a rig designed for 2000 feet. The rest, as they say, is history. At that time deep wells were drilled with cable tool standard rigs. Calhoun brought a rush of drilling contractors to the area to develop the newly found Oriskany sand field.

By the late 1950's the Leidy field development had moved to the Driftwood-Rockton-Luthersburg field of Clearfield County. At that time I had left the familiar shallow Venango sand oil fields to go to Penfield-DuBois area where drilling was being done with rotary tools at depths of 7000 to 7200 feet. This was a place where air rotary drilling was first developed in the Appalachian area. The early rotary drilled wells were first drilled to 1500-2000 feet using a cable tool rig (usually a Bucyrus-Erie 48-L spudder) to drill the very hard Upper Devonian sandstones and limestones. This was because at those shallow depths not enough weight could be developed by short lengths of drill pipe and drill collars to achieve acceptable penetration rates with a rotary rig. Surface casing was then run and cemented by Halliburton. The presence of old abandoned coal mine workings and shallow water zones also would complicate conventional rotary drilling at these depths. Using cable tool drilling techniques solved most of these problems. Once the spudder was moved off and the rotary replaced it, the remainder of the hole could be drilled *dry* using compressed air for circulation. With air drilling the sample cuttings were very small, often the size of face powder. This required microscopic examination of the cuttings for sample analysis. Because of my interest in geology, the company's well site geologist, Carl Roberts, taught me how

to do this with a 10x hand lens. Later we used a binocular microscope at up to 20x power.

Once the rotary rig started with air drilling, the main part of the hole was fairly quickly drilled as the remaining Upper Devonian section contained almost no water to hinder *dry* air drilling. This portion of the hole took less than 2 weeks if no drilling problems such as a twist off or bit problems developed. Cable tool drilling had previously taken as long as six months for a complete well.

The key marker bed for the Oriskany gas sand was the Onondaga limestone at average depths of 6800 – 7100 feet. This is a very hard layer that instantly decreased the penetration rate, becoming a good marker for the drillers to identify. At this point, Carl Roberts came out and carefully examined the samples to look for the layer of chert (a form of quartz found in the limestone) in the Onondaga as a marker for the placement of seven-inch production casing for completion of a producing gas well. The seven-inch casing was then run by the rig and cemented by Halliburton. Because of the fineness of the samples, the chert identification had to be done by someone with geologic skills. Generally this was beyond the skills of the drilling crews, thus the employment of a professional geologist.

After setting and cementing the seven-inch casing, drilling of a smaller hole continued until reaching the Oriskany gas zone. However, big problems could develop by drilling into a gas zone with air. The gas to air mixture could be very explosive causing a downhole fire and explosion. Several holes were lost when plugged with melted drill pipe due to the intense heat generated. To solve this, two procedures were adapted. Some companies moved a cable tool spudder in after the rotary rig set the seven-inch casing, drilling the rest of the hole with cable tools. Because of the depth and hardness of the rock, it was painfully slow. It took a good cable tool driller to make a bit drill at the end of a mile and quarter length of steel cable. Also, drilling into a high-pressure gas zone could cause the tools to be blown out of the hole and various other calamities. All of this took time and money.

The other solution to the downhole fire problem was to continue drilling with the rotary rig, but to use natural gas rather than air as the circulating medium. The gas was taken from the local field gathering lines at line pressure of several hundred p.s.i. and forced down the drill pipe and then blew the cuttings up to the surface. This gas flow was then flared (burned off) in a separate cleared site in the woods away from the rig and well equipment. This process made it very easy to know when the prolific Oriskany zone with its high-pressure gas was penetrated. The easy way of seeing this is when the size of the flare greatly increased due to the influx of new gas over and above that being used for cutting circulation.

The development of air rotary drilling was pioneered by Delta Drilling Co. from Texas, one of the four rotary contractors in the area. The other three came along as they developed the various techniques. These three were Lohman-Johnson Drilling Co. from state of Indiana, Fairman Bros. (Punxsutawney, PA) and Sam Jack (Avonmore PA). Both Fairman and Jack were older local cable tool drillers who made the transition to rotary. Because air rotary drilling was so new to the area, the tool pushers and drillers were from out of state while local boys made up the rest of the rig crews. As the locals gained experience as rig hands, they gradually moved up to driller and tool pusher positions. By the early sixties with improvement in air compressor packages, bit technology and rig equipment it was possible to now drill the entire hole using the rotary rig. The cable tool rigs, like old soldiers, *just faded away* for deep wells.

After the drilling phase most of the wells received a small frac treatment from Halliburton using water and sand. In the late 50's most wells were fraced to enhance production even if a large natural flow of gas was encountered. The entire open-hole section from the bottom of the seven-inch casing to a point in the Oriskany where drilling stopped was fraced in one stage usually 1000 to 1500 barrels of water total. The chert section was thought to be part of the gas-producing zone. However, it was felt that the Oriskany took the better part of the treatment. Later, a number of serious geologists used the name *Ridgely Sandstone* in place of the familiar Oriskany name. To us in the field, however, it was always Oriskany.

After frac, the well pressure was blown off and much of the frac fluid recovered before the well was turned into the gas transmission pipeline. Most wells did not penetrate the entire Oriskany section as salt water was thought to be present in the lower portions of that zone. These wells at that time cost around $ 90,000.00 each and with gas selling at $ .70 per MCF, some of these paid off within ninety days. The largest well I heard of in the field had an open flow of 45 MMCF/day. The biggest well I personally worked on had an open flow of 16 MMCF/day.

The company I worked for was Devonian Gas and Oil Corp. which was a successor to Dorcie Calhoun's original company Leidy Prospecting Co.

To bring us up to the present, when the cable tools drilled thru the shale zones above the Oriskany we occasionally got good gas shows of short duration. Some of them were large enough that they would throw the drilling tools up the hole, causing the drilling cable to kink and get jammed. To eliminate this problem, some wells were drilled with the hole loaded with salt water to control these *gas pockets in shale*. Today some of these zones are named the Marcellus shale. In the fifties these were just considered a nuisance as the gas was

in *just shale*. At this point and into the early sixties the main field was essentially drilled up and the drillers moved to other areas.

For those of us who experienced it and *made the boom*, it was a great adventure as new techniques were developed. These central Pennsylvania gas fields helped perpetuate the local drilling industry that was started over a hundred years previously by Col. Drake.