FUTURE OF NATURAL GAS IN OKLAHOMA

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In Oklahoma, as in most other regions, natural gas is found associated with petroleum. While it is true that there are in the State a few gas wells in which the amount of petroleum produced is negligible, and there are some oil wells which produce but little gas, the fact remains that in at least 90 per cent. of the wells, both substances are found. This is only what might be expected when the nature of the two products is understood. Petroleum and natural gas are but two manifestations of the same series of chemical compounds, one being the gaseous, the other the liquid form. This being true, it is obvious that any discussion regarding the location of natural gas must necessarily include petroleum also.

It is not the purpose at this time to enter into any discussion regarding the origin of oil and gas. The smoke of the battle still hangs over us. Partisans of the chemical theory and of the organic theory still contend valiantly. This matter does not concern us today. We do not care whether oil and gas are formed by the action of hot water on carbides of certain metals, or whether it is the result of long-continued distillation of animal and plant remains, which were buried in the rocks in by-gone days. There are just three things which we, as members of the Natural Gas Association of America wish to know; First, Where is the gas located? second, How much is there of it? and third, How can it best be utilized? It is to a brief discussion of these three questions as they relate to conditions in Oklahoma, the state which you have today honored by your presence, that I desire to call your attention.

First: Where in Oklahoma has natural gas been found, and where may we expect to find additional deposits?

On the upper right-hand corner of the map which I have placed in your hands, I have attempted to indicate in a general way the location of the oil and gas producing regions of Oklahoma. The cross-barred area indicates what has been called the

probable oil field, the region in which oil and gas will probably be found. The area in parallel lines is the possible oil field; and the solid black, the developed fields. By comparing this map with the map of the coal fields, you can not fail to notice that the probable oil field of Oklahoma coincides very closely with the coal field, extending from the Kansas line south about as far as Atoka and east to the Arkansas line. The matter might be stated differently, that is, it might be said that in Oklahoma, oil and gas occur in the Coal Measures rocks.

Coal, which is derived from vegetable matter, is found either in rocks of carboniferous age, or in younger rocks, chiefly cretaceous and tertiary. Oil, which is probably derived from both plant and animal remains, is found in rocks of practically all geological ages, from the Cambrian, the earliest of stratified rocks, up to practically the latest. The oil of the Indiana field, for instance, is found in very old rocks; the Trenton formation, of Ordovician age. Much of the oil in Pennsylvania, West Virginia, Kentucky and eastern Ohio comes from Devonian or Mississippian rocks. Oil in the Illinois, Kansas and Oklahoma fields comes from the Coal Measures rocks. At Pueblo, Colo., and Corsicana, Texas, oil is obtained in Cretaceous formations, while the Beaumont oil and the oil in the California fields comes from Tertiary rocks, which are of very recent geological age.

The probable oil field in Oklahoma coincides, then very closely with the coal field. It will be noted that the greater number of productive areas, indicated on the map as solid black lie in the northern part of the State. This is largely due to the fact that development began at the Kansas line, and has moved southward, slowly and methodically. The first wells were drilled along the 96th meridian, and in the Shallow field, so-called, farther east. At the present time, the development has progressed about as far south as Muskogee and Okmulgee. No oil has as yet been found in the probable field south of the Canadian river, but there are geological reasons for believing that within the next few years, when development has progressed that far, some of the most productive pools in Oklahoma will be found in the region between Atoka and the Arkansas line. In fact, it is altogether probable that had development begun near Atoka, McAlester or Fort Smith, only the southern part of the Oklahoma field would have been developed today, and the Musko-

gee, Morris, Bartlesville, and Glenn fields would have yet been undiscovered.

The area which is designated on the map as the possible oil field of Oklahoma lies west and south of the probable field, extending as a belt from the Kansas line south to the Arbuckle Mountains, passing around these mountains, and east, north of Red river, to the Arkansas line. There is also a small area surrounding the Wichita mountains. Within this area, oil or gas, or both, have been found, at a number of points, namely at Blackwell and Ponca in the northern part of the State; at Madill and Wheeler, south of the Arbuckle mountains, and at Lawton, Cotebo and Granite, near the Wichita mountains. It is extremely probable that future development in these regions will reveal the presence of a number of additional pools. The chances, however, for finding oil and gas in this region are not so good as in the region designated as the probable oil field.

There are five general regions in Oklahoma in which the chances are not good for finding oil and gas, namely: The centers of the four mountain regions and the great Redbeds area which occupies central and western Oklahoma. The Ozark Uplift in the northeastern part of the State; the Ouachita mountain region in the southeastern part; the Arbuckles in the south central part and the Wichitas in the southwestern, show no possibilities for oil or gas. In addition to these four doubtful areas, it is unlikely that oil or gas will ever be found in quantity anywhere in the Redbeds. At various times drilling has been done and a great amount of money has been spent in the Redbeds in the central and western counties. It has been estimated that during the last ten years at least $25,000 a year, or a quarter of a million dollars in all, has been spent in drilling holes in the Redbeds in the vain hope of finding oil or gas, and up to the present time, not a dollar has ever come back.

The geology of the oil and gas fields of northeastern Oklahoma is comparatively simple. The rocks consist of a series of alternating beds of sandstones and shales with a few limestone ledges, belonging to the Coal Measures age. The greater part of these rocks lie nearly level or dip at low angles to the west, the average dip being perhaps 20 feet to the mile. In certain places this regular westward dip is interrupted by folds, that is, anticlines and synclines, which run usually nearly parallel to the

strike of the rocks; that is to say the axes of the anticlines and synclines run nearly north and south. In many places where there is no well marked anticline it may be noticed that the rocks instead of dipping west, lie nearly level, forming what is sometimes known as an arrested anticline.

It is not necessary to stop here and explain to members of this association the well-known anticlinal theory of oil and gas formation, promulgated by Dr. I. C. White, State Geologist of West Virginia, and others. According to this theory gas should, under normal conditions, be found most abundantly along the axis or crest of the anticline; oil along the slopes of the anticline; while water, usually salt water, occurs in the snycline.

While it would not be correct to say that this theory holds good in all places in Oklahoma, the general statement may be made that the greater number of the oil and gas fields in northern Oklahoma are in regions where the normal westward dip of the rocks has been interrupted. In many fields, as for instance, near Bartlesville and in the Glenn Pool, there is a well-marked anticline. Some three years ago, I had the privilege of standing with Dr. White on one of the isolated knobs near the eastern end of the Glenn Pool not more than half a mile from the Ida Glenn lease, from which the pool takes its name, and with him tracing out the location of the axis of the anticline along which the greater part of the strongest gas wells in the pool occur. On the other hand, there are oil and gas fields in Oklahoma where the geological structure is more obscure and where there are no anticlines which may be observed from the surface.

Another factor which must always be taken into consideration in Oklahoma, as well as other known oil fields, is the shape and lithologic character of the oil and gas-bearing sands. If the sand is thin, it can hold but little oil or gas; if it is thick, it can hold much larger deposits. If the sand is fine-grained and practically impervious, but little oil or gas can pass through it. If it is coarse-grained and porous, large amounts of oil or gas may be stored up. So that other things being equal, the thicker the sand and the more porous the material, the larger the amount of oil or gas contained therein. Thin beds of fine-grained sand can carry but little if any, oil or gas. From this it will be readily understood that the most prolific oil or gas fields must necessarily occur in regions where a thick bed of porous sand is

located along an anticline. These conditions seem to obtain at Glenn Pool, where the sand is more than 100 feet thick, as well as at Bartlesville, in the Muskogee field, and at a number of other prominent fields in the State. Wherever a pumpkin-seed-shaped bed of porous sand occurs in a region where the rocks either lie level or where there is a pronounced dip to the east, oil and gas have usually been found. On the other hand, in several cases, dry sands of considerable thickness have been found along anticlines, while along others only thin sands carrying a small amount of oil have been encountered.

All this is to say that while a geologist may often be of some practical benefit to the oil man in the matter of eliminating risk and indicating the locality where *not* to drill, he can never be absolutely certain that oil or gas, or in fact, any other mineral, exists beneath the surface. The only way to determine certainly the presence of these substances is to drill.

Even if no drilling had ever been done in Oklahoma, it would not be difficult to argue the presence of oil or gas beneath the surface. There are a number of places in the State where asphalt, the residuum of petroleum, appears on the surface. Several of these localities are in northeastern Oklahoma at points where we now know that oil and gas-bearing sands appear on the surface. Asphalt occurs in considerable quantities in the vicinity of the Arbuckle mountains also, for instance, near Ada, where lower Carboniferous rocks approach the surface.

Burning springs are found in several parts of the State, the most notable being in northeastern Pittsburg county, some 20 miles northeast of McAlester. At this point, gas escapes over an area of perhaps 300 square feet, along a little ravine. It issues from crevices in the soil and among the rocks, and when set on fire often continues burning for weeks and even months. It is extremely significant that this spring is located near the crest of an anticline. Drilling near this burning spring, has. however, revealed no oil and but a small quantity of gas.

The geologist well understands that oil springs and gas escaping on the surface usually means that the chances are not good for finding a large amount of the material at hand. If the spring occurs along an anticline, it frequently means that the rocks have been fractured and the material now escaping has been escaping for a long time and is, therefore, practically exhausted.

If found in a region of gently tilted rock, it indicates that the hydrocarbon has been carried for a considerable distance, probably for several miles along the bedding plane, and that drilling should be done at some point other than in the vicinity of the spring. These facts, however, are not always understood by the so-called practical oil driller, and much money has been spent in Oklahoma in attempting to find oil or gas near oil springs or gas vents.

In Oklahoma, as in other states, the natural mound hallucination is prevalent. Throughout a number of the eastern counties, the flat prairies and even the wooded areas are often dotted with small natural mounds, varying in size up to 50 feet in diameter and often 3 or 4 feet in height. The superstition that these mounds in some way indicate the presence of gas is wide-spread. They are called gas blows or gas mounds, and many people really believe that a well put down in the middle of one of these mounds will encounter gas. It is needless to say that this notion has no foundation in fact and whatever may be the origin of these natural mounds, they are not connected in any way with any deep-seated supply of gas.

Second: This brings us to the second division of our subject; namely, How much natural gas is there in Oklahoma? The answer is easy. Nobody knows.

All that we can say is that the deposits are enormous, but at the present time there are not sufficient data to enable us to estimate accurately their possible amount. Practically every oil well so far drilled in the State produces gas, while at the same time many of the strongest gas wells do not contain oil. The daily capacity of an Oklahoma gas well varies from a few cubic feet per day up to millions of cubic feet. The average sized well in the Tulsa or Bartlesville region runs all the way from 1,000,000 to 10,000,000 cubic feet per day. Wells in various parts of the State have been reported to produce 40,000,000; 50,000,000 and even 60,000,000 cubic feet per day.

According to the statistics of the United States Geological Survey, there were, at the close of 1908, 474 gas wells in Oklahoma. This is probably not more than half the actual number now in existence. Gas wells are strung all along the 96th meridian from the Kansas line to Henryetta. Some of the strongest wells with a capacity running up into the tens of millions of feet per

day are located in the Shallow field, the Morris field, the Bald Hill field and the Muskogee field, while other wells equally good are located at Wainwright, Pawhuska and in the Preston Pool. Smaller amounts have been found in dozens of localities scattered everywhere throughout the field.

Any estimate of the amount of gas actually in sight in Oklahoma is little better than a guess. There are no accurate data and even an approximation may of necessity be misleading. Taking into account all known facts, however, and estimating as nearly as possible the amount from the various wells, including those now being utilized, those shut in, and those going to waste, the amount of gas already discovered in Oklahoma should be somewhere between 1,500,000,000 and 3,000,000,000 cubic feet per day. A conservative approximation would probably be 2,000,000,000 cubic feet daily.

But if we attempt to go a step further from a conjecture as to the amount of gas which may yet be discovered in Oklahoma, we are at once confronted with the inadequacy of language and the paucity of figures. Those of us who have traveled over the developed fields of Oklahoma, studying the problem from a scientific standpoint, believe that at the present time not one-fifth, or possibly not one-tenth of the gas in those fields has yet been touched. In many cases only a single well to the square mile has been drilled in search of oil. Gas having been found, for which there is no demand, the entire territory has been condemned, and the field abandoned. Possibly the well has been plugged, but most likely it still stands open, permitting the escape of the gas.

Now from a study of the map it will be seen that not one-tenth, of the probable gas field of the State has been developed. In the region south of Muskogee and Okmulgee there has been practically no drilling as yet, but this is a region in which the geologist believes that there should be vast untapped reserves of gas and oil. Even the geologist with his well-known inclination to estimate things in hundreds of millions, stands aghast before the unknown possibilities of the future development of the Oklahoma gas field.

Natural gas is now being utilized to a limited extent for manufacturing and domestic purposes in the region in which it is produced. Such towns as Bartlesville, Dewey, Cleveland, Col-

linsville, Mounds, Wagoner, Claremore, Morris, Boynton, Wann, Blackwell, Chelsea, Bigheart, Pawhuska, Taneha, Ochelata, Ramona, Tulsa, Skiatook, Nowata, Talala, Lenapah, Sapulpa, Okmulgee, Muskogee, Ponca and Coweta use gas, produced usually within a few miles of the city, for lighting and heating purposes. In a number of cases, gas is used for industrial purposes. For instance, Bartlesville has zinc smelters, Dewey has a Portland cement mill and a number of towns in the gas fields have brick plants that use gas. A pipe line from the Tulsa-Glenn Pool region supplies Oklahoma City, Edmond, Guthrie, Chandler and Shawnee. Ardmore uses gas piped from the Wheeler field 20 miles distant.

The price of fuel varies directly with the distance it has to be piped. In Tulsa and Bartlesville, to cite two examples, where the gas is produced near at hand, prices are about ten cents per thousand cubic feet for domestic use and two to four cents for manufacturing purposes. Several towns in this region have advertised two cent gas and one and one-half cent gas for factories. In Oklahoma City, where the gas is piped over a hundred miles, the price is twenty-five cents per thousand for domestic use and ten cents for factory use.

It is obviously impossible to accurately estimate the life of the oil and gas fields of Oklahoma. Ordinarily these substances are exhausted within a few years after the reservoir containing them has been tapped. It is well known that the life of the ordinary oil well or gas well does not usually exceed five years. Some of the wells are exhausted in a year or two, others produce a small quantity of oil for ten, twenty, or even forty years. Some of the first wells drilled in Pennsylvania in the late 60's are still producing. On the other hand, the famous Beaumont field, which was at one time the wonder of the world, is now practically exhausted. The Indiana gas field is nearly exhausted. Many of the first wells drilled in southern Kansas and northern Oklahoma, have already ceased to produce oil or gas in paying quantities.

It must be remembered, however, that as I have already stated, only a relatively small part of the oil and gas region of Oklahoma has ever been prospected and a still smaller part developed. There is enough prospective territory untouched in Oklahoma to keep the drillers busy for the next fifty years.

Counting fifty years more for the life of the last wells brought in, and assuming that the greater part of the gas will be utilized and not permitted to go to waste, we may approximate 100 years as the life of the oil and gas field of Oklahoma. This estimate is probably under, rather than over the actual time limit.

At a conservative estimate not to exceed 10 per cent., possibly not more than 5 per cent. of the gas so far discovered is now being utilized. Part of it is shut in waiting a chance for utilization, but much of it is going to waste. One can not drive anywhere through the gas field of northeastern Oklahoma without being shocked at the prodigal waste of fuel now going on. In hundreds of places, gas is permitted to burn day and night without ceasing. Scores of wells are permitted to flow unchecked, and this priceless fuel is being dissipated into the air. A law which was passed by the last legislature, the object of which was to attempt to conserve the natural gas, has done much to check this waste, but in many sections it is yet more honored in the breach than in the observance. At the present time in Oklahoma a vast amount, possibly hundreds of millions of cubic feet a day of the best fuel the world has ever known, is permitted to escape into the air.

In territorial days little attempt was made to save the gas. To cite but one instance out of a hundred; when gas was first encountered in Bartlesville, it was permitted to escape unchecked. The roaring of the gas was so persistent that people in the town could not sleep at night, and so the gas was carried in pipes outside of the city limits, where it might escape without the noise disturbing the sleepers.

The following paragraph from a current periodical will give some idea of present conditions in the State.

"The party took a run down to the new Preston oil field. While there accurate measurements were made of the gas well recently brought in, and it was shown to be good for 36,000,000 cubic feet per day. This is the largest gas well ever developed in the southern Creek country and one of the largest that has been completed recently in Oklahoma. Its magnitude was a surprise, even to the owners of the well. It has been running wild ever since it was brought in and the roar of the escaping gas can be heard for miles. The owners are purposely allowing the

gas to go to waste with the belief that the well will finally drill itself into oil."

The following quotation from a letter written April 4th, 1910, by a member of your association will give an idea of the situation from the view point of a practical gas man:

"There are millions of feet of natural gas going to waste in this State, due largely to carelessness and neglect by the many producers in drilling for oil. It seems their sole aim is to drill through the gas bearing strata in order to secure the oil, as the oil can be marketed more readily and the gas has a very limited market. While this is being done the gas is allowed to go to waste; in fact very little attention is paid to it. In many cases the well is drilled into salt water, which destroys it entirely as a gas well. Only recently in the new Hamilton Switch pool there have been no less than fifty to seventy million cubic feet of gas blowing away, in fact, enough to supply the whole state of Oklahoma, every day, with apparently no effort on the part of the producer to prevent it. There are some of the wells in this Pool which came in having a capacity as large as 36,000,000 cubic feet per day. We feel that the gas is just as marketable and valuable a product as the oil and that a well which is drilled in having a capacity of from two to four million cubic feet per day should be shut in to save the gas, as it looks like a crime to allow the gas to go to waste in this manner."

It is greatly to be regretted that some really effective plan has not been devised to curtail the prodigal waste of this valuable fuel, which has been going on in eastern Oklahoma for the past ten years, and which is still in progress. For this there is no excuse except the cupidity of man. The well having been drilled, in search of oil, and gas having been encountered, for which there is no immediate demand, it is easier to pull the tools, letting the well stand open, permitting the escape of the gas, than it is to plug the well. In many cases, as the one above cited, a gas well with a capacity of many millions of cubic feet per day is permitted to flow unchecked in the hope that it will some day drill into oil. In scores of instances wells which produce ten or twenty barrels of oil and say 5,000,000 or 10,000,000 cubic feet of gas a day are permitted to flow unchecked. The gas is all wasted to save the small amount of oil. When it is remembered that 6000 cubic feet of gas has a fuel value equivalent to a barrel of

oil, it will be understood that 6,000,000 cubic feet of gas equals a thousand barrels of oil. So in the case cited the equivalent of 1000 barrels of oil, is permitted to go to waste each day in order to save ten or twenty barrels. For these reasons, Oklahoma is day after day losing hundreds of thousands of dollars worth of valuable fuel, which should be saved for future generations. This waste is nothing short of criminal, and it is high time that the people of Oklahoma, as of other gas-producing states, were awakening to a realization of conditions.

One point should be clearly kept in mind, namely, that these fuels, once gone, are gone forever. You may take all the water from a well and the rainfall will restore the water. You may exhaust the fertility of the soil, but by careful cropping and fertilizing, the fertility may be renewed. You may cut down the forests, and new forests will grow, but when you take from the earth the minerals, the oil, the gas, the coal, contained therein these minerals are never replaced.

In this connection it may not be out of place to quote a statement made by Dr. White at the congress of governors at Washington two years ago:

"For just as sure as the sun shines, and the sum of two and two is four, unless this insane riot of destruction and waste of our fuel resources which has characterized the past century shall be speedily ended, our industrial power and supremacy, will, after a meteor-like existence, revert, before the close of the present century, to those nations that conserve and prize at their proper value their priceless treasures of carbon."

Third: How may this vast amount of fuel be best utilized?

By referring again to the maps showing the distribution of the mineral resources of the State, and comparing these with the oil and gas map, you can but note the proximity of the gas belt to most of the other minerals. Now by referring to the chart showing the approximate abundance of the minerals, you may be able to form some idea as to the ultimate utilization of our gas.

Oklahoma is rich in mineral. Few states surpass us either in variety or amount. But today this mineral lies dormant in our hills and not one-half of one per cent. of it is being utilized. We, in Oklahoma, use Kansas brick, tile, cement and salt; Arkansas and Texas alike; Vermont marble; Scotch granite; Texas

gypsum plaster; Indiana and Missouri limestone; Illinois glass sand, and asphalt from the oil refineries, and we pay the freight on all of it, although we have inexhaustible deposits of all these materials in our own hills. The reasons for importing these products are obvious. The other states have their mines and quarries opened already, and their plants established, while we have not.

Oklahoma is the baby state. There are nearly two million of us here and we are all from somewhere. I'm from Ohio. My next door neighbor is from Texas, and the man across the street hails from Wisconsin, while his neighbor is from North Carolina. We came here of our own volition because we knew that Oklahoma had the makings of the grandest state of the Union. We understood when we came that we were coming to a new state and so we are willing to endure pioneer conditions just as long as necessary, but no longer. We are proud of the fact that no equal area that the sun shines upon has made such rapid advancement in the same length of time as has Oklahoma in the past five years, and we are yet only fairly started. Get out of the way and watch us grow, or better still, cast your lot with us and help us grow.

We are *trying* to keep our gas at home. We need it. It is true that we have been wasting it about as fast as we could, but at the same time, we don't want you alls to take any of it away. What we do want is for you to locate factories here that will utilize our fuel. We have a plenty and to spare. If the gas fields are ever exhausted, we have a few billion tons of coal to fall back on. (The United States Geological Survey says we have 75,000,000,000 tons) but we are not worried about the gas failing for several years yet. But right in the gas fields or within short piping distance, there are inexhaustible deposits of as good clay as that found in Ohio or New Jersey.; of as fine glass sand as that of Illinois or Pennsylvania; of Portland cement rock as good as can be found anywhere in the world. There is also limestone for burning into lime; lead and zinc deposits among the most prolific on the continent, besides sandstone, marble, granite and asphalt, all in enormous quantities. A little farther away, there are 123,000,000,000 tons of gypsum, and salt water enough going to waste to make 100 car loads of salt a day.

We need these things developed. We must have them de-

veloped before Oklahoma comes to her own, and we believe that if we can keep our gas at home the development will come all the sooner. If the gas is piped out of the State, Oklahoma will derive very little benefit from it. If it is utilized at home, it means the establishment here of hundreds of industrial plants and factories and the opening of scores of mines and quarries, all of which go toward the development of our State.

Are we selfish? Perhaps so. Are we playing dog in the manger? We do not think so. What we are trying to do is to devise the most effective means of developing in the shortest possible time, our enormous natural resources. We have the mineral wealth and the fuel for its manufacture Come in with us and help us to make Oklahoma great.