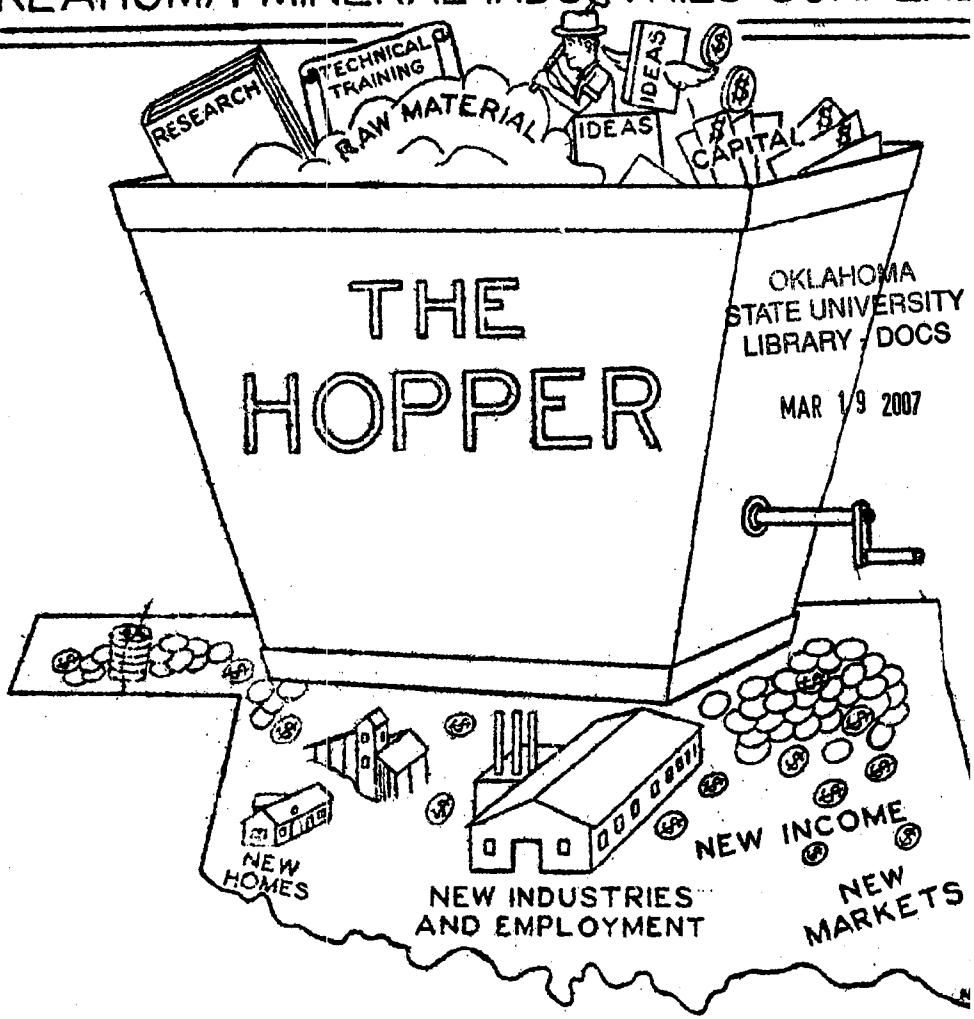
OKLAHOMA MINERAL INDUSTRIES CONFERE



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GROUNDWATER SUPPLIES IN OKLAHOMA AND THEIR DEVELOPMENT

By

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Part II

Economical search for a municipal water supply from ground water depends on information, involving application of both geology and engineering, and in addition, large amounts of common sense. It must start with an investigation of local geology to determine the nature of any aquifers that may be present, supplemented by an inventory of existing wells--their locations, depths, water levels, and quality of water and drillers' logs. Geological and well data permit predictions as to necessary depth of drilling, casing, and the order of magnitude of probable yield.

The better the information obtained during drilling of the well, the better will be the job of completing it, and the more satisfactory will be the well. Maximum yields will depend, first of all, on the proper perforation of casing opposite water sands, and the accuracy with which perforation points are selected may mean the difference between a good and a poor well. Drillers' logs, and even sample logs made by a geologist are subject to human errors.

Logs of wells. Both electric logs run before casing is set, and gamma-ray (radio-active) logs made with casing in the hole are of proven worth and reliability, and in deep wells costing several thousands of dollars, the cost of the service for making such logs is cheap insurance for accurate perforation. If the electric log is used, perforations can be made on top of the ground, before

casing is run; if the gamma-ray log is used, the casing is perforated in the hole with a gun-perforator. Interpretation of the logs is done by the companies, but it is advisible that they be checked by a geologist familiar with such logs.

Pumping test. A short-term pumping test of 48 hours duration, with an accurate record of the volume of water pumped, and measurement of drawdown and recovery of water levels in near-by observation wells, provides data that can be used to predict very accurately the proper spacing and safe yield of wells, and the size of pump that will be required. No program of developing a new supply that will involve more than one well, or of expanding an existing supply by additional wells, should be undertaken without such pumping tests to determine proper spacing of wells. A large proportion of failures of municipal ground water supplies in Oklahoma can be attributed to the drilling of too many wells in small areas where operating convenience has had priority over proper spacing.

Observation wells. A program of periodic measurements of water levels will establish a record of water-level fluctuations that is highly important in determining the behavior of the aquifer under operating conditions. Observation wells should be at sufficient distance from pumped wells so as not to be affected by pump surge. Such a record over sufficient length of time will differentiate the seasonal variations from long-time trends, and thus give data for estimating the recharge of the aquifer and the the safe yield, above which withdrawals should not go.

Proper application of these factors of spacing and pumpage will provide a stable and efficient water supply, wherein each well carries its proper share of the load, and together, all wells in the well-field produce an annual volume of water that does not exceed the annual re-charge. Safe devel-

opment means taking an annual harvest instead of mining through drawing on storage. It may be compared to using the interest on one's investment, rather than using up the principal. The supply is limited by the thickness and permeability of the aquifer, and such limits are definite.

Role of the Geological Surveys. The State of Oklahoma, through the Oklahoma Geological Survey, in cooperation with the Ground Water Division, U. S. Geological Survey, on a matched-funds basis, has maintained a program of ground-water investigations since 1937. This program is carried out by a geologist of the Federal Survey who is in charge, an engineer of the Federal Survey, and a geologist of the State Survey. The program consists of systematic investigations of large areas, such as counties, periodic measurements of water levels in about 185 observation wells, and services to communities having problems of ground water supply. This staff is altogether too small to handle a job of such magnitude and of such tremendous importance to the State of Oklahoma.

Service is available to any community on request by some responsible official to the Director of the Oklahoma Geological Survey, and will be undertaken as expeditiously as conditions permit.

Communities can help themselves, and greatly assist the ground water program if they will (1) keep accurate records of water pumped, preferably by the month; (2) make measurements of water levels in observation wells at regular intervals, at least twice per year. The geological surveys will be glad to furnish instructions for this work; furnish steel tapes for the purpose, if necessary, and interpret the data. As water-level fluctuations of a few hundredths of a foot may be significant, measurements must meet that degree of accuracy; (3) furnish us copies of drillers logs of wells; (4) keep the geological surveys advised of contemplated

drilling of wells so we may arrange to obtain logs and samples, and perhaps participate in pumping tests. A drillers' record or log book has recently been printed for distribution by the Geological Survey, and copies will gladly be furnished to any driller of water wells, on request.

Water is vitally necessary for the continued happiness and prosperity of Oklahoma people, and will play an important role in future industrial and agricultural development, and growth of population. Ground water has distinct advantages for many uses, and in many situations, and if there is any possible means of meeting such needs, the Geological Surveys will do their best to find it.

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GROUND WATER AT HIGH STAGE IN OKLAHOMA PANHANDLE

By Stuart L. Schoff
Prepared in cooperation between the U. S. Geological Survey and the Oklahoma Geological Survey
June 1948

Despite relatively dry weather during recent months, the amount of ground water stored in the principal water-bearing formations of the Oklahoma Panhandle was greater in May 1948 than at any time in the last 10 years.

Measurements of water levels in 51 observation wells were made about the middle of May as part of the investigation of the ground-water resources of Oklahoma conducted cooperatively by the Oklahoma Geological Survey and the United States Geological Survey. An average taking into account the relative importance of several different water-bearing formations shows that the ground water stood about half a foot higher than in October 1947; and more than 3 feet higher than in November 1938, when the lowest level was recorded.

It is especially significant that the water levels were highest in the beds of sand and gravel underlying the High Plains, for these form the largest ground-water reservoir in the Panhandle and furnish most of the water for farms, towns, and industries. The water levels in the alluvial sediments along the principal streams of the area were intermediate between the recorded high and low levels.

The high water levels in the Oklahoma Panhandle are in strong contrast with the widely publicized shortages of both surface and ground water in many parts of the United States, although they do not mean that those shortages are unimportant. The shortages have been most serious where large quantities of water are required for cities, industries, and irrigation. In the Oklahoma Panhandle, the consumption of ground water although far from negligible, is still small in relation to the capacity of the underground reservoir. That the reservoir could be depleted is indicated by the effects of heavy pumping for irrigation in parts of the High Plains in Texas, notably in the region south of Amarillo. Although the occurrence, movement, and rate of replenishment of ground water there are much the same as in the Oklahoma Panhandle, the ground-water levels have showed substantial declines.

The records for the Oklahoma Panhandle show no correlation between the water levels and individual rains or even rainy seasons, but instead indicate that from 1 to 3 years may elapse after the beginning of a climatic cycle before an observable change occurs in the water table. The measurements, which were begun in Texas County in 1937 and in Beaver and Cimarron Counties in 1938, near the end of several years of drought, showed no consistent trend until early in 1941. Thereafter, the average for the Oklahoma Panhandle has risen gradually to the level recorded in May of this year. A slow down-

ward trend should be expected if several dry years follow each other.

Over the period of record, the rise in water levels has been greatest in Cimarron County, where, however, the average for May 1948 was 0.05 foot lower than last October. This decline is small and does not indicate the beginning of a persistent decline. On the contrary, it is traceable to the relatively low stage of water levels in observation wells tapping the alluvium. This aquifer occurs in only a small part of the area, and accordingly is given small weight in the average, but the water levels in it declined an average of nearly 3 feet between October and May, offsetting an average rise of 0.73 foot in the observation wells on the upland plains.

The average for Texas County, which has shown the smallest rise during the period of record, was 0.24 foot above the previous high level and a total of 2.55 feet above the record low of November 1939. In the observation wells on the upland plains, the average of the water levels was the highest yet recorded, but for wells along the major streams the average was intermediate between the highest and lowest on record.

The average for Beaver County was nearly half a foot above the previous high level, recorded in April 1947. The average for wells in the northwestern part of the county exceeded the previous record by 0.31 foot, and the average for the southeastern part was 0.96 foot above the previous high level, but, as in the other two counties, the water levels in wells along the valleys were at intermediate stages.

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A CHEMIST ASSAYS AND ESSAYS ON NATURAL GAS

by A. L. Burwell
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The Scotch have a salutation which is accorded newly married couples. The newly-weds are greeted with "Lang may your lum reek" which translated into English is "Long may your chimney smoke". To the American such a greeting would not be accepted as entirely friendly. As a matter of fact, usually it would appear to be positively unfriendly. To the Scotchman the greeting is highly acceptable and significant because smoke issuing from the family chimney denotes prosperity within. Therefore, "Land may your lum reek" expresses the wish that the newly-weds may always be prosperous. To the Scot, prosperity fulfills his greatest desire.

Coal, the raw material generally associated with and largely responsible for black smoke, remains the principle source of energy in most industrial areas. In many places coal will continue to do so. Chimneys and stacks belching black smoke will still proclaim that a district is potent industrially and that prosperity abounds, because to all intent and purpose industry and prosperity are synonomous. But chimneys and smoke are not the criterion upon which to judge activity and prosperity in Oklahoma and other districts of the southwest.

In Oklahoma, black smoke does not serve as a measure of prosperity either for an industrial enterprise or of the people of the state. Neither do chimneys on homes indicate the degree of prosperity of the inmates unless the formula ratio of chimneys and smoke to prosperity is the reverse of the Scotch concept. The real means for measuring prosperity in Oklahoma is the appearance of the people, their homes, and environment, the appearance of the

cities and villages, the appearance of the industrial buildings, factories, and mills, and the cleanliness and freedom from soot and grime. Visitors from other parts of the country make the comment that Oklahoma homes and business houses are positively attractive.

If there is any one factor upon which one can put a finger and say THIS factor is in a large measure responsible for prosperity in Oklahoma, it would be natural mineral resources, and among the most important is natural gas. Natural gas is clean, easy to handle and transport, high in fuel value and low in fuel cost. In many parts of the country it is not unusual to hear the expression, "Now you are cooking with gas", when it is desired to impress the idea of attainment, of arriving at an objective, of "getting somewhere", of "really going to town". The meaning and derivation of the expression is obvious. In Oklahoma, an appropriate greeting to newly-weds might well be "May you always cook with gas", because it expresses a desire that the recipient may be prosperous and also have happiness and contentment as exemplified by natural gas serviced homes and industry in Oklahoma.

In addition to its advantages as a source of power, natural gas possesses a definite advantage as a source of heat for chemical and metallurgical operations because of the absence of ash. Coal, coke, wood, and even heavy petroleum fuel oils may introduce objectionable impurities into a product through contact with or absorption of ash components. The only inorganic element likely to be carried by natural gas is sulfur. Certainly sulfur is objectionable in many processes but it can, however, be removed from natural gas by methods that are neither difficult or costly, usually less than 0.5 cents per M cubic feet.

Natural gas is fast finding itself as a source-raw material for the chemical industry. The use of

natural gas for the production of carbon black is well known but recent technical advances in methods and types of product are not so well known. In 1945, four plants in Oklahoma produced 53,192,000 pounds of carbon black valued at $1,987,000.00 from 8,170,000 M' Cubic feet of natural gas costing $327,000.00, thus showing a fine example of "values created through manufacture".

The utilization of natural gas as raw material for other chemical production is evident in the new plants already in operation or under construction in Texas, Louisiana, and West Virginia. The Cities Service Company plant at Tallant in Oklahoma is another, where formaldehyde and formaldehyde derivatives, methanol, and acetone are among the products made from natural gas by controlled catalytic oxidation. Plants in Texas produce similar lines, acetic acid being probably the most important. Formaldehyde is a necessary raw material in the manufacture of several plastics, whereas acetic acid is a basic raw material in others, especially the "acetate" textiles. Acetic acid is also an essential raw material for several solvents largely used in paints and lacquers.

Natural gas is a raw material for other lines of chemical industry, too. The synthesis of ethyl alcohol from natural gas as practiced at Baton Rouge is an example. The nitration of natural gas hydrocarbons as conducted by Commercial Solvents is another. The decomposition and conversion of natural gas into hydrogen and carbon monoxide, and their use in the synthesis of methanol and of ammonia and nitric acid is still another. The latter process is utilized at Pittsburg, Kansas.

Another use for natural gas, not always recognized as yielding chemicals although it definitely is, is the synthesis of motor fuel—gasoline, by the Fischer-Tropsch process. This process will serve as the basis of the new plant now under con-

struction for the production of gasoline and other chemicals from gas of the Hugoton field of Kansas and Oklahoma.

In his circular on the Utilization of Natural Gas for Chemical Products (U. S. Bureau of Mines Inf. Cir. 7108, April 1940), Harold M. Smith, Petroleum Chemist with the Bureau of Mines at Bartlesville, shows the processes by means of graphs. Although Mr. Smith covered the field as thoroughly as possible, he felt constrained to write:

"The Industry is developing so rapidly that some products may have been ommitted.....The difficulty of keeping information of this type up to date is shown by reference to an information circular on the same subject published by the Bureau of Mines in 1930, in which the important products are shown on a single chart, whereas five charts are employed for the same purpose at present."

The production of chemicals from natural gas on a tonnage basis or on a value basis has increased probably much more than Mr. Smith's 1 to 5 ratio indicates.

It seems obvious that although natural gas has played such a large part in the development of Oklahoma, contributing so much towards cleanliness, happiness and contentment, yet Oklahoma has not and is not now making the most of the opportunities offered by availability of natural gas. The establishment of more and diverse industries in Oklahoma using natural gas for heat and power, and as raw material for the production of intermediates for distribution to other manufacturing centers and for conversion to consumer products for its own trade territory, these should be the objective to strive for. If this objective is attained, all Oklahoma will benefit. Then there will be added reason for greeting our newly-weds with--"May you always cook with gas".