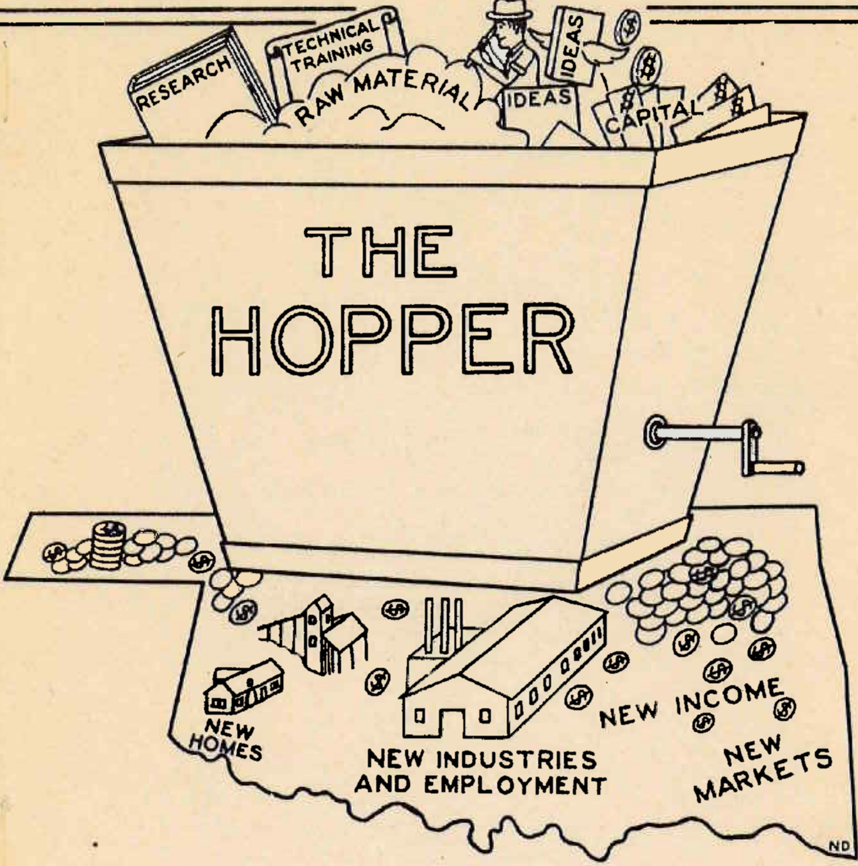
DEDICATED TO OKLAHOMA'S DEVELOPMENT



PUBLISHED IN THE OFFICE OF THE
OKLAHOMA GEOLOGICAL SURVEY
NORMAN, OKLA.

Vol. 15
No. 4

April, 1955

GEOLOGY AND MINERAL RESOURCES

OF

HUGHES COUNTY, OKLAHOMA

OKLAHOMA GEOLOGICAL SURVEY BULLETIN 70, MARCH, 1955

By O. D. Weaver, Jr.

ABSTRACT

The primary purposes of this investigation were: (1) to study in detail the character, distribution, and thickness of the rock formations and to prepare a detailed areal geologic map; (2) to trace northward formations already mapped to the south and west of Hughes County and correlate them with the formations of northeastern Oklahoma and southeastern Kansas; (3) to study the fossils present in the various formations and make a faunal and floral range chart; (4) to determine the age and correlation of several producing oil sands that crop updip to the east of Hughes County; (5) to map the faults in the area; (6) to locate and describe mineral deposits of possible economic value.

The surface rocks in Hughes County are of Pennsylvanian and Quaternary age and were mapped in detail. The Pennsylvanian rocks include ten formations which range in age from the Boggy formation of middle Desmoinesian age up to the Coffeyville formation of lower Missourian age. The Quaternary deposits include high level gravels, drape deposits, terrace deposits, the Gerty sand, and flood plain deposits. Sixty-five units of sandstone, conglomerate, shale, and limestone, as well as all formational contacts, were mapped by the writer and appear on the geologic map.

Wewoka Creek and Little River show evidence of having played a much more important role in the drainage of the county in the past. Broad flood plains and extensive terrace deposits testify to the past size and extent of these streams. Muddy Boggy, Sand, Panther, and Caney Boggy Creeks drain the south part of the county and flow southward into the Red River. They have high gradients and are actively enlarging their drainage basins to the north at the expense of the South Canadian River. The South Canadian River once flowed southeastward from the vicinity of Allen across southern Hughes, northeastern Coal, and central Pittsburg Counties and rejoined its present channel just south of Eufaula in southern McIntosh County. The Gerty sand of Hughes and adjoining counties roughly outlines the past course of this stream. An abrupt change from southeast to northeast that occurred just southeast of Hughes County was caused by the Ashland anticline in northeastern Coal County. Little River was an important tributary to the South Canadian River at that time and flowedacross Hughes and northern Pittsburg Counties in the channel now occupied by the South Canadian River. A tributary of Little River worked its way southward from the vicinity of Atwood and cut into the channel of the South Canadian River, diverting it northward into its present channel.

A distinct change occurs in the character of the beds lying above the Boggy formation. Coarse chert conglomerates are common in the Thurman and succeeding formations, and the shale intervals separating the successive sandstone units become thinner. Coarse chert conglomerates do not occur in Hughes County north of a northwest-trending line through the central part of the county. These conglomerates typically do not thicken toward the south but grade laterally to finer-grained sedi--

ments both to the northeast and the southwest. This indicates a southeastern or possibly a southern source of these gravels.

Numerous sandstone and siltstone tongues are present at the base of the Calvin sandstone. These tongues wedge out to the northeast along the strike of the beds and to the northwest in the subsurface. The presence of these tongues and certain other physical properties of this unit indicate that the condition of deposition was that of a large delta, with the streams that deposited the tongues shifting irregularly across its surface.

The Homer and the Sasakwa limestones of the Holdenville formation are not present north of the vicinity of Spaulding in the west-central part of the county. The limestone that occurs on the fair grounds at Holdenville is not the Homer limestone but is a thin limestone near the base of the Holdenville formation. Surface mapping indicates that the contact between the Des Moines and Missouri series is conformable in Hughes County. The Coffeyville formation of northeastern Oklahoma and southeastern Kansas was traced southwest across Hughes County and found to be the equivalent of the lower part of the Francis formation as mapped in the Stonewall quadrangle. The Checkerboard limestone, which lies immediately below the Coffeyville formation in Okfuskee County to the north, is not present in Hughes County. The DeNay limestone, the basal unit of the Francis formation as mapped to the southwest of Hughes County, is not present north of the west-central part of the county. This limestone occupies the same stratigraphic position as that of the Checkerboard limestone to the north and is considered to be its equivalent.

Though most of the fossils occurring in the

Pennsylvanian rocks in Hughes County are long ranging, the forms **Mesolobus mesolobus**, "Marginifera" muricatina and Delocrinus granulosus appear to be limited to the Des Moines series.

Deposits of volcanic ash present in the Dustin area are associated with high terrace deposits of the North Canadian River and are probably of Quaternary age.

The southeast edge of the central Oklahoma uplift or platform, a subsurface feature, trends northeastward across the central and northeastern parts of Hughes County. The McAlester basin lies to the south and includes the southeastern part of the county. The oldest Pennsylvanian rocks present beneath the county are of Morrowan age. The Morrowan and the overlying Atokan rocks are very thick to the southeast of Hughes County but thin rapidly across central Hughes County as they pass northwest out of the McAlester basin. An important unconformity is present at the base of the Atoka series in the subsurface of this area. The upper part of the Wapanucka shale is truncated, and the Wapanucka lime is not present northwest of the north-central part of the county. The Des Moines series overlies the Atoka series unconformably in the subsurface. This unconformity cutsout the entire Atoka section to the northwest of Hughes County. Formational contacts and many of the individual units of the formations that crop out in Hughes County can be traced accurately into subsurface. Changes in thickness and character of the units may be interpreted. The exposed formations thin to the west in the subsurface and at places grade into shale. The "Senora limestone" of the subsurface crops out across northeastern and east-central Hughes County. This limestone lies near the top of the lower Senora sandstone unit of the surface. The oil produced at about

1,700 feet in the Olympic field of northwestern Hughes and southern Okfuskee Counties is from sandstones which occur in the upper part of the lower Senora sandstone of the surface. The "Calvin sandstone", which produces oil in the subsurface of western Hughes, Seminole, and Okfuskee Counties, is equivalent to only the lower part of the Calvin sandstone of the surface. The "Wetumka shale" of the subsurface is a silty shale zone within the Calvin formation of the surface. Oil fields in Hughes County are limited to the area north and west of the outcrop of the lower part of the Calvin sandstone. This belt trends northeast across the county and roughly coincides with the southeastern edge of the central Oklahoma uplift. Gas production is obtained to the east of this zone, however. The change from basin to shelf environment occurs in this "hinge zone," and the occurrence of oil and gas is directly affected by the change.

CLIFF WALDEN SEEKS GREENER PASTURES

Clifford Walden, geologic draftsman with the Survey since 1953 has joined the staff of British-American Oil Co. in Ardmore. Cliff drafted the black base for the Arbuckle Mountain map, the Baum limestone map, and many other of the better maps published by the Survey. We are indeed sorry to loose him and the benefit of his talents. British-American is sure to have excellent maps.

GROUND-WATER RESOURCES OF OTTAWA COUNTY, OKLAHOMA

OKLAHOMA GEOLOGICAL SURVEY, BULLETIN 72
Issued February, 1955

By Edwin W. Reed, Engineer,

and

Stuart L. Schoff, Geologist

and

Carl C. Branson, Geologist

ABSTRACT

Ottawa County, in the northeastern corner of Oklahoma, is nearly square, has an area of 504 square miles, and has a population of about 32,000 (1950). Miami, the county seat, had a population of 11,703, in 1950.

The southeastern half of the county is in the Ozark plateau, is hilly and well **timbered**, and has a surface relief of several hundred feet. The northwestern half is in the Osage section of the Central Lowlands and is largely flat prairie. The county is drained by the Neosho (Grand) and Spring Rivers.

The mining and milling of lead and zinc ores ranked as the most important industry in the county until 1944, when The B. F. Goodrich Co. established a tire-manufacturing plant at Miami. This industry is about equal in importance to mining and milling, and its large requirement for cooling water emphasized the need for an appraisal of ground-water resources.

Limestone, chert, shale, and sandstone, of Paleozoic age, underlie the surface of Ottawa County. Those exposed, in ascending order, are divided into the Boone formation, Hindsville limestone, Batesville sandstone, and Fayetteville shale, of Mississippian age, and the Krebs group, of Pennsylvanian age. These formations are overlain along the larger streams by alluvium and at other places they are overlain by terrace deposits. Locally, also, they are overlain by gravel and clay thought to be of Pleistocene age. Of these formations, the Boone offers the most promise as an aquifer. The water in it has been used mainly on farms.

Subsurface sedimentary rocks comprise more than 1,000 feet of cherty, oolitic, or sandy dolomite, and sandstone, of Cambriam and Ordovician age; eight formations are recognized, the lower three being assigned to the Upper Cambrian and the upper five to the Canadian series of the Ordovician system. The Seneca fault, Miami syncline, and local structural features modify the regional dip, which is 15 to 20 feet per mile northwestward on the flank of the Ozark uplift. Granite of pre-Cambrian age has been encountered below the sedimentary rocks.

Rocks of the Canadian series are the source of the source of all municipal water supplies in the county. Their intake area is in the Ozarks, many miles to the east, and wells tapping them are generally 1,000 to 1,300 feet deep and are cased and cemented to exclude water from overlying strata. Within the series, the Roubidoux formation is the most prolific. It consists of dolomite containing two or three sandy zones, and in wells it ranges from 105 to 180 feet in thickness. The top of it has been found at depths from 880 to 1,020 feet. Most of the water appears to come from the sandy zones, and some wells yield up to 600 gallons per minute. Although rather hard, the water has a relatively low total mineral content.

When wells first tapped the water in the rocks of the Canadian series, about 1900, the artesian pressure was sufficient to make them flow. By 1918 most wells had stopped flowing, and by 1947 the lift was more than 500 feet in some wells. The greatest decline in water levels has occurred near Miami.

Three controlled pumping tests on wells of The B. F. Goodrich Co. were analyzed according to Theis nonequilibrium formula, and yielded 13 values for coefficient of transmissibility. These range from 22,200 gallons per day per foot to 59,400, and average 38,100. Because the wells used in the tests are near the axis of the Miami syncline, this average is believed to be somewhat lower than normal for the Canadian series, and a value of 40,000 gallons per day per foot is used in further computations. From the same tests, 12 values for the coefficient of storage were obtained and 1 x 10 is regarded as average for this coefficient.

The Miami syncline and Seneca fault are believed to be barriers that obstruct the flow of ground water from remote parts of the aquifer to the Miami area, thereby increasing the drawdown in pumping wells. It is estimated that if one well were to be pumped at 400 gallons per minute, and if six other nearby wells were to be pumped at a combined rate of 2,200 gallons per minute, the total drawdown in the first well at the end of 5 years of continuous pumping would be about 450 feet.

The rocks of the Canadian series of Ottawa County appear to function as a hugh reservoir.

Water levels will decline as long as pumping continues. The rate of decline will diminish if the pumping rate remains unchanged, but will increase if the pumping rate is materially increased. If present rates of withdrawal are to be maintained, pump bowls ultimately will have to be lowered. The reservoir still should furnish many millions of gallons of water, although at increasing cost occasioned by increasing pumping lift. If an economical and practical method could be found to recharge the reservoir artifically, the trend might be reversed.

Survey Geologist Catches Uranium Fever

The virus of uranium fever has infected a member of the Survey staff. Gerald W. Chase, associate geologist, is now on leave-of-absence to join a uranium-producing partnership in New Mexico. Chase was the Survey's expert on the Wichita Mountain area, on titanium, and on uranium. He is the author of Oklahoma Geological Survey, Mineral Report 26, "Radioactive Materials in Sandstone Lenses of Southwestern Oklahoma", Circular 30, "Ilmenite Sands in the Wichita Mountain area", and "Geology Map of Raggedy Mountains."

Evelyn and the children will continue to reside in Norman for the present. Gerald embarks upon his Geiger-counter work on March 1.

W. E. Ham Discusses Arbuckle Dolomite

Dr. W. E. Ham of our staff gave a paper entitled "Origin of the dolomites in the Arbuckle group in the Arbuckle Mountains" before the 625 attendants of the Fourth Subsurface Geological Symposium, held on March 1 and 2 in the University of Oklahoma Student Union. The paper was rendered more than ordinarily timely by the recent discovery of oil deep in the Arbuckle rocks by the Frankfort Oil Co. in sec. 4, T. 1 S., R. 1 E., about 4 miles west of Davis and just north of the Arbuckle Mountains.

The dolomites of the Arbuckle group may be divided into three general types, each having been formed at a different time and under a quite different environment.

Most important of these types is dolomite that occurs in sequences of regional extent which shows stratigraphic characters like common limestones, including normal bedding, lamination, cross-lamination, scour-and-fill, and rhythmic interstratification with other rocks. The best representatives of this rock type in the Arbuckle group are the Royer and Butterly dolomites and the dolomite unit at the top of the West Spring Creek formation, each of which is 300-700 feet thick and is widely distributed throughout the Arbuckle Mountains. These stratigraphic units consist mostly of bedded dolomite but contain locally some beds and lenses of limestone.

The second type of dolomite occurs in the form of irregular small patches in limestone. Known to most geologists as mottled dolomitic limestone, these rocks are best developed in thick sequences where calcitic facies predominate. They generally are regional in distribution and are characteristic of a particular sequence, and are most common in the Fort Sill, Signal Mountain, McKenzie Hill, and Kindblade formations in the western and central parts of the Arbuckle Mountains. They also are present to a lesser degree in nearly all limestones of the Arbuckle group.

Generally the dolomite grains are arranged in the form of clusters, knots, or irregular patches that weather into slight relief above the surrounding limestone surface. Gross form of the dolomite cluster in some limestones is controlled by localization of granular material, especially in worm trails, in the matrix of intraformational pebble conglomerates, and in the matrix within and surrounding algal colonies. In other limestones there is no apparent control and the dolomite has random distribution.

The third occurrence of dolomite in the Arbuckle group is a type well known to mining geologists but not fully appreciated by others. It occurs as irregularly shaped bodies that are characterized by irregular and locally abrupt lateral transition into limestone away from faults and fissures. These bodies are plainly epigenetic and were formed in Pennsylvanian time. They occur in all limestones of the Arbuckle group in all parts of the Arbuckle Mountains, but the bodies are more numerous, thicker, and more extensive in the south-central part of the region.

The largest bodies of fault-controlled dolomite originate from faults with stratigraphic displacement normally less than 100 feet; and practically no dolomite is associated with the larger through-going faults. The extent to which dolomitization may occur is illustrated by an area in secs. 10 and 11, T. 3 S., R. 4 E., Johnston County, where a sequence of dolomite embracing all the

McKenzie Hill formation and the lower part of the Cool Creek formation, a thickness of approximately 1,100 feet, grades away from a fault irregularly into limestone within a distance of 2.5 miles, and most of this lateral transition takes place within 1 mile. A half mile on the other side of the controlling fault the McKenzie Hill formation consists of limestone except for two thin stringers of dolomite. The outcrop area of this dolomite covers slightly more than 1 square mile, and is large enough to localize an oil pool if its porosity is greater than that of the surrounding limestone.

Dolomites in the Arbuckle group that are associated with faulting were formed by replacement of limestone, probably when the faults originated in Middle and Upper Pennsylvanian time. The dolomitizing solutions most likely were magnesium-rich connate waters trapped within rocks of the Arbuckle group, and freed for migration as a result of tectonic disturbance.

Stratigraphic-type dolomites, the most common type in the Arbuckle group, originated in Cambrian-Ordovician time and derived their magnesium from sea water, the only reasonable source for the element in the many cubic miles of this rock. Some of the laminated dolomites in this group may have formed by direct precipitation, but most were formed by replacement of lime muds or limestone which still had contact with sea water. Replacement criteria are everywhere evident and indicate overwhelmingly that calcite was present in the space now occupied by dolomite. The time of replacement is shown to be penecontemporaneous with deposition of the beds, as indicated particularly by the widespread occurrence of detrital dolomite grains and by long-continued rhythmic alteration of limestone and dolomite laminae. Some rhythmic layers are plainly varves, consisting of carbon-rich and carbon-poor layers, which indicate that dolomitization in one layer probably took place within a single year.

Mottled dolomitic limestones generally are related to algae, some of whose remains are known to be relatively rich in magnesium carbonate and which, upon reorganization during diagenesis, would be converted partly to dolomite. Those mottled rocks that are not associated with algae probably originated from connate waters, the dolomite crystals so long as a supply of magnesium was available or until the waters escaped in Pennsylvanian time.

Attempts to distinguish genetic types of dolomite by index of refraction studies have not yielded conclusive results, and the best method now known to interpret origin is from detailed field relations.

The discovery of oil by the Frankfort Oil Company 1,000 feet below the top of the Arbuckle is the first major occurrence of Arbuckle oil in southern Oklahoma. Samples from the well have not yet been released, but it seems probable that the oil is obtained from dolomites in the West Spring Creek formation of the Arbuckle group. As this formation on the outcrop near the well is mostly limestone, the dolomitized zone in the well may be an epigenetic body related to faulting, of the type that is well known from outcrop studies in the central part of the Arbuckle Mountains.

New Pay horizons in the deeply buried Arbuckle rocks are thus opened for additional drilling, both on the margins of the Arbuckle Mountains and elsewhere in southern Oklahoma.

Oklahoma Chemical Industry in 1975

by A. L. Burwell

There is a thought-provoking article in the November 29th issue of Chemical and Engineering News under the caption "Southern Chemical Industry 1975". Everyone who professes a desire to see Oklahoma progress industrially should read this article. From a consideration of raw material availability no section of the country is better situated: Petroleum, Natural gas, Coal, Limestone, Dolomite, Silica, Salt, etc.

> "Today a third of the nation's chemical industry is in the South; this may increase to a half in 10 years."

C&EN attributes much of this growth to the efforts of the Southern Association of Science and Industry. This organization known as the SASI recommended to the recent Southern Governors' Conference that it use its influence to expand programs of industrial research and scientific education. It pointed out the big discrepancy between what the southern states spend for agricultural development and what they spend for industrial research, asking more funds by the states for basic research into the industrial resources of the region. SASI predicts that in the next 10 years there will be at least 200 multi-million dollar plants built in the South to make products which do not exist today. Oklahomans will be encouraged by this prediction. It is good news.

In the same issue of C&EN is a survey of chemical industry construction for the 12 months ending October 31, 1954. A table shows the "planned" construction, "under construction", and "completed" construction for each of the 48 states.

Completed construction in Oklahoma amounted to $22,750,000, which is 1.87% of the United States total. Under construction in Oklahoma is $7,000,000, which is only 0.75% of the United States total. Under planned construction Oklahoma has none, being one of twelve states in this category. Thirty-six states have planned chemical industry construction. All southern states excepting Oklahoma and Arkansas are in this latter group. This is bad news.

It isn't raw material availability. Then what's the matter? What's the matter?

Status of Publications

Geologic Map of Arbuckle Mountains, by W. E. Ham and M. E. McKinley. Issued February, 1955. Price $2.00 postpaid.

Bulletin 70 - Geology and Mineral resources of Hughes County, by O. D. Weaver, Jr. Map issued December, 1954. Bulletin issued March 1, 1955. Map $1.25, Bulletin (with map) $2.10.

Bulletin 71 - Geology and mineral resources of Okfuskee County, by E. R. Ries. Map issued December, 1954. Bulletin issued March, 1955. Map $1.25. Bulletin (with map) $2.50.

Bulletin 72. Ground water resources of Ottawa County, by E. W. Reed and S. L. Schoff. Issued February 9, 1955. $1.75.

Bulletin 73. Geology and ground water resources of Grady County, by L. V. Davis. In press. Copy has been read in page proof, map in press.

Circular 32. Spore flora of Croweburg coal, by L. R. Wilson and W. S. Hoffmeister. Scheduled.

Circular 33. Geology and economic possibilities of Baum limestone, by J. R. Wayland and W. E. Ham. In press.

Circular 34. Geology of the core of the Ouachita Mountains, by W. D. Pitt. In press.

Mineral Report 27. Uranium in Oklahoma, 1955. In press.

Map 72-1. Mineral Map of Oklahoma, by J. H. Warren. In press.

Map 72-2. Ground water resources map of Oklahoma. In Washington office of U. S. Geological Survey for their approval.

Mineral Report 28. Economic possibilities of Henryhouse marlstone, by A. L. Burwell. Final tests of samples being run.

Map 72-3. Magnetics map of Oklahoma. Scheduled.

Map 72-4. Gravity map of Oklahoma. Scheduled.

Bulletin 74. Geology and mineral resources of Seminole County. Manuscript ready to go to press, map being drafted.

Dr. Jordan Joins Survey Staff

On April 16, 1955, Dr. Louise Jordan became a member of the Survey geological staff. She is working on subsurface geology, a field in which much work of survey type is needed. It is planned to publish an adequate chapter on subsurface in each county report. Dr. Jordan will study regional problems and prepare maps, cross-sections and reports on various subsurface problems.

Miss Jordan is widely traveled. She has lived in many of the states and in Turkey. She graduated from Wellesley and received her Ph.D. degree from Massachusetts Institute of Technology. She taught at Mount Holyoke and in Turkey, and was geologist with Sun Oil Co., with Anzac Oil Co., and in the Middle East. She has had Survey experience and has several publications to her credit.

Miss Jordan will work closely with oil and gas geologists and in order to start getting acquainted, she will attend the Arbuckle Mountain field trip in April. The Survey is glad to have a competent subsurface geologist on its staff and welcomes Dr. Jordan to Oklahoma.